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RESEARCH ARTICLE

Enhancing Students' Performance through Feedback Mining System using Sentimental Analysis

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ABSTRACT

Because of Covid, All the universities and schools were led the classes in internet-based mode, so their instructing were in web-based stage. In internet-based class, students lost their learning interest by keeping their mobile mute, so they had less learning time contrasted with disconnected class. Presently lockdown has been finished, classes are right now in regular, so forthcoming exam are intended to be in regular. Student will have pressure for going to the test in regular, Questions will be asked to students, teachers and parents. These answers are analyzed for student mentality towards offline exam. So that the student option mentality will be clearly known. Teachers can view the answers in their login for better understanding of the students. All their answers will be analyzed and the result will be shown in chart. Every one of their responses will be analyzed and the outcome will be displayed in the graph.

Keywords: web-based stage, student mentality, responses, pressure, Stress.

INTRODUCTION

Sentimental investigation is a technique for recognizing the feeling communicated in texts. The need of Sentiment Analysis of message has acquired significance in the present circumstances looked by individuals of the world. For the most part, there are three methodologies in nostalgic investigation. They are dictionary based, AI and half and half methodology. Because of Covid, All the universities and schools were led the classes in web-based mode, so their educating were in web-based stage. In internet-based class, understudies lost their learning interest by keeping

their telephone quiet, so they had less learning time contrasted with disconnected class. India has been one of the huge regions in the world when it related to high level training. At any rate, on the web and distance courses have been there from a long time, show of the internet-based technique for taking classes in judgment to the traditional eye to eye 40homeroom system in schools and colleges have been assessed exceptionally in the last relatively few previous years in India. With respect to the Indian educational structure, very close homeroom methodology has reliably been the most plainly used. Shared characteristic and straightforwardness of using separated procedures and nonappearance of responsibility for online channels of teaching has been the critical limits for allotment of online channels of preparing. Not with remaining, in that frame of mind of current COVID-19 infection situation transmission of online classes at school and school level has been made necessary by the enlightening sheets. Covid has attracted out an extreme change the educational structure in India as well as all the entire world.

Existing System

Student will go to psychiatrist doctor regarding the mentality of the student where student will be given some set of questions. Student interest will be identified based on the answers whether he is interested in studies or extra-curricular activities. If the student is studying 10std, they have no idea for selecting 11 std group and if the student is studying 12std, they have no idea in choosing their career. So, they are confused and have mental pressure.

Disadvantages

- Student will have fear regarding for visiting the hospital.
- They have anxiety for answering the questions Infront of parents.
- Student will think that the doctor will brainwash as per parent wish.
- Sometimes, consulting cost will be high.

Proposed System

Now lockdown has been completed, classes are currently in offline, so upcoming exams are planned to be in offline. Students will have struggles for writing the offline exam such that fear of exam, writing speed will have been reduced, concentration problem. Students, parents will answer the 10 Question through their login. These answers are analysed for student mentality towards offline exam. So that the student option mentality will be clearly known. Teachers can view the answers in their login for better understanding of the students. All their answers will be analysed and the result will be shown in chart.

Advantages of proposed system

- App model is easy for teachers, parents and students.
- Easy to handle.
- Analysing time is less compared to existing system.
- Student will not get tensed for answering the question.
- They can answer the questions anywhere in the world.
- Stress level will be reduced by answering the question so that their mentality will be identified and the result will be shown accurately.

Block Diagram

Related Work

Splash screen:

It is the home page which consist of sentiment analysis that automatically moves to selection page which contains of four buttons namely admin login, staff login, student login and parent login.

Admin login

Admin has to undergo the registration process. admin must register by giving mail id and password. After the registration process, admin has to login by providing his mail id and the password. Admin has the authority for registering the teachers. All the Questions answered by the parents and students will be handled by the admin.

Teacher login

Teacher has the authority for student registration. Teacher can view the student answers by the student Registration number.

Student login

Student will answer the 10 questions by providing their registration number and these answers will be viewed by the teacher page and also the admin. By answering the questions, they don't have fear and feel relaxed. They have satisfaction for analysing their mindset.

Question module

Student will have fear for offline examination, to know the mentality of the students, there will be 10 questions for the students and parents. The questions will be displayed in students and parents' login

Output visualization

All the answers made by the students and the parent will be analyzed and the result will be shown in the chart. Finally, the student prefers the online or offline exam possibilities will be clearly known.

CONCLUSIONS

Understudy Feedback System is worked to investigate information and showed the understudy mindset and accordingly decreases the pressure against the disconnected test. This framework utilizes preprocessing, point extraction, bunching, characterization to address the understudy sees in a graph. This framework will be valuable to further develop the understudy learning psyche and along these lines decreases the feeling of anxiety. While internet learning absence of foundation and equipment offices on the unwavering quality of the internet learning and furthermore no or less expertise of PC base information. Internet learning isn't center or genuine advancing as contrast with customary strategy or disconnected framework. The majority of understudies are differed for the disconnected test and they need online test because of the internet learning.

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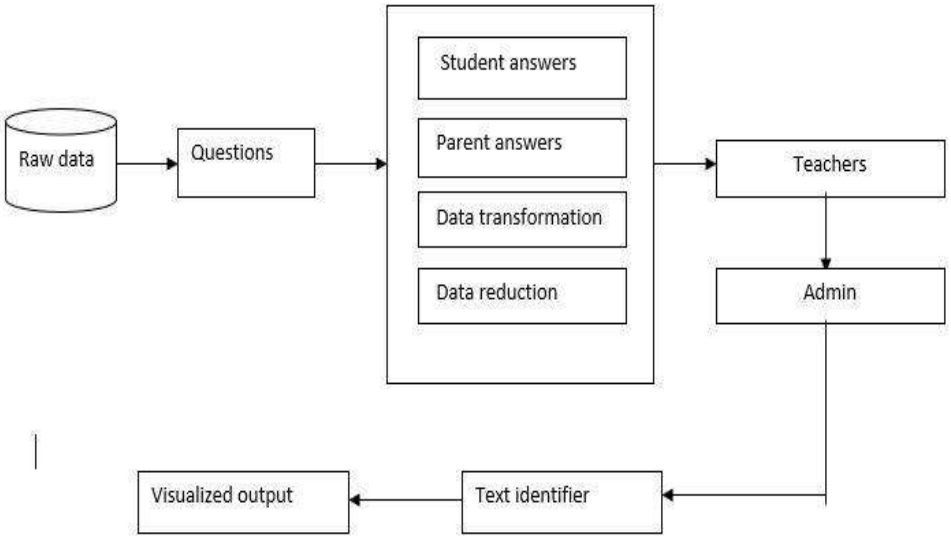

Fig.1 Block Diagram

REVIEW ARTICLE

Mine Spoil Reclamation through Ornamental and Landscape Gardening- A Review

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ABSTRACT

In the total available land area of 14 billion hectares in the world, only around 3.2 billion hectares are arable or potentially arable with minimum environmental hindrance. The increasing pace of industrialisation also brought more of vegetative area under threat. Among the industries, mining is one which is being considered to be the biggest destroyer of land by mining and over burden. The physico-chemical analysis of the minespoil revealed that the spoil is structureless with high bulk density, low exchangeable ions with deprived status of nutrients and low organic carbon which collectively affect the plant growth. Natural recovery of minespoil and traditional method of revegetation is a slow process. Successful reclamation of minespoil depends on two main approaches viz., 1. Modifying the environment to suit the plant and 2. Generating or selecting the plants to suit the prevailing environment. Since the first approach is laborious and cost intensive, major efforts has been directed towards the second approach.This paper reviews the utility of certain ornamental plant species for gardening in disturbed overburden mine land area based on their adaptability, photosynthetic efficiency, soil binding properties and tolerance to high stress conditions. Some of the plants like hyper accumulators are capable of growing in very high concentrations of metals. These plants are of interest for their ability to extract metals from the spoils of contaminated sites and to return the ecosystem to a less toxic state. Moreover, some of the trees, grasses, legumes, palms and other group of ornamental plants were identified to grow satisfactorily after the incorporation of low cost amendments. Just by using these plants, a beautiful arboretum, turf, xeriscape, water garden like ornamental and landscape gardens could be established to ensure the environmental sustainability and socio-economic activities of the problematic mined land area. The success of reclamation can be evaluated with the reclaimed mine spoil index (RMSI) as plant

performance data. This paper reviews the criteria and procedure for successful reclamation of minespoil area by ornamental and landscape gardening based revegetation.

Keywords: Mine spoil revegetation, Plant species, Hyperaccumulators, RMSI, Amendments, Reclamation, Ornamental and landscape gardening.

INTRODUCTION

Mining is one of the most important productive industries in the world. Various kinds of minerals and sources of energy such as coal, lignite etc. are being obtained by the mining process. In the actual process of mining, the area is completely stripped off of vegetation and the subsoil is removed in order to reach the lignite bed, where the over-burden spoil is dumped on the barren land. Hence, both the mined and barren lands are affected because of the bare soil which is lacking in life supporting parameters such as soil nutrients, organic matter, soil texture, structure, microorganisms etc. The overburden lignite mine spoil could be comparable to compacted soils which restricts aeration and root penetration (Manoharan, 1989). Such spoils generally will not support plant growth and production as they exert direct influence on the ability of plant roots to extract nutrients and moisture. Natural recovery of minespoil is a slow process and traditional methods of afforestation often prove inadequate. Taking into consideration of these aspects, research activities on reclamation received considerable attention. Successful cultivation of crop species under such situations depends on two main approaches viz., (a) modifying the environment to suit the plant (b) generating or selecting plants to suit the prevailing environment. Since the first approach is laborious and cost intensive, major effects to overcome this problems has been directed towards the second approach.

Several researches throughout the world have attempted a number of studies on reclamation and revegetation of minespoil. In India, systematic work has been initiated in recent years towards these objectives (Dadhwal *et al*., 1988). So far, the principle method adopted to stabilize the disturbed mine land is through establishing vegetation as it encourages the growth of beneficial species (LeRoy and Keller, 1972). Since the profile in the minespoil is completely disturbed, it is very much inhospitable for the growth of commercial plant species as such. At the same time, afforestation in minespoil gives scope as most of the mined lands where deforested before mining, moreover, trees perform well even under low nutrient status, poor texture and structure and compacted substrate, which are typical characters of minespoil. Besides, some of the native vegetation like forage grasses and legumes were identified to grow satisfactorily after taking up necessary measures for improving the soil properties through incorporation of fertilizers (Skousen *et al.,* 1989 and Schoenholtz *et al.,* 1992), wood residue, sewage sludge and combination of different organic and inorganic amendments (Dancer and Jansen, 1981; Voorhees *et al.,* 1987; Moss *et al.,* 1989 and Karuppaiah and Manivannan,2009).Taking into consideration of the above aspects, the literatures on charactering the minespoil and identifying various ornamental plant species, suitable amendments and technologies for the establishment of ornamental and landscape garden are reviewed and discussed hereunder.

Vegetation in the minespoil

There is a natural abundance in genetic diversity among plants to come up well even under mine stress, in the different kinds of mines all over the world. The leguminous plants were found to be the best for growing in the minespoil as the fast spreading and nitrogen fixing ones which have been reported by Vogel and Berry (1968); Jones *et al*. (1975); Johnson (1976) and Graffney and Dickerson (1981). The work of Dadhwal (1987) proved that subabul (*Leucaena leucocephala*) Cv. K-8 to be a good species for growing in the abandoned limestone mines in the Missouri hills of Uttar Pradesh, India. Clark Ashby *et al*. (1989) found the performance of tall fescue (*Festuca arundiraceae* Shreb) was satisfactory in the coal minespoil of South Illinois, USA.

According to Power *et al*. (1978), spring wheat grass (*Agropyron cristatum* L.) and crested wheat grass (*Elytrigia intermedia* Beauv) were found to be suitable for growing in mined lands of North Dakota while Klein grass (*Panicum coloratum*L.) performed well in lignite minespoils of Texas, USA as reported by Chichester and Hauser (1984). Graffney and Dickerson (1981) identified certain warm season grasses like switch grass (*Panicum virgatum* L.) and big blue stem (*Poa partensis*) for growing in Illinois spoils. Corn and soybeans were also found to be the best for coal minespoils of Rogers country, Oklahoma, USA (Jansen, 1987).

In the case of deep-rooted species, Gupta (1978) reported that the *Bauhinia retusa* was the best suited for the limestone minespoil of western Himalayas. Vogel (1977) reported that careful species selection could provide a range of tolerances to match the poor minespoil without amendments and also listed thirty two tree species, nine shrubs, sixteen herbaceous legumes and twenty five grass species suitable for growing in the coal mine strips in USA with good plant vigour. Plass (1975) recommended that the forest shrubs and tree species were the desirable components for the vegetative cover on the mined sites whereas forestry and wild life uses were contemplated.

Maiti (1997) conducted an experiment in the coal minespoil heaps at the Jharia coal field in India using the legume (*Sylosanthes humilis*) and the grass (*Pennisetum pedicellatum*) in a ratio of 1:2 to provide vegetation cover and to improve the spoil area. After three years, the spoil fraction had increased to forty five per cent and the pH had decreased from 7.8 to 6.8, whereas the conductivity was reduced from 0.73 to 0.30 dsm^{-1}. The organic carbon content of the spoil increased significantly by 140 and 79 per cent at the end of 2^{nd} and 3^{rd} year, respectively. The nitrogen accumulation had increased upto 715 kg ha^{-1} depending on the composition of spoil material, climate and legume growth. Through the exchangeable potassium was 270 kg ha^{-1} after three years and the phosphorus content was deficient. For the screening and selection of suitable plant species to be grown in the minespoil, while many workers have used growth characters, Sheel and Gibson (1996) used physiological characters such as photosynthetic rate, stomatal conductance, chlorophyll content and transpiration as the screening and selection criteria for the minespoil, Carbondale, USA. They screened many species using these criteria and identified *Andropogon gerarii, Panicum virgatum* and *Sorghastrum nutans* as the suitable species for the coal minespoil. The various plant species, which were found to be more suitable for different minespoil area, as reported by many workers have been presented below (Table 1.)

Hyper Accumulator Plants

A hyper accumulator is a plant capable of a growing in water with high concentrations of metals, absorbing these metals through their roots and concentrating extremely high levels of metals in their tissues. These plants are of interest for their ability to extract metals from the soils of contaminated sites to return the ecosystem to a less toxic state. The plants also hold potential to be used to mine metals from soils with very high concentrations by growing the plants, then harvesting them for the metals in their tissues. Some of the hyper accumulated plants are fireweed(*Crassocephalumcrepidioides)* , Black nightshade (*Solanum nigrum L.),* sword fern (*Polystichummunitum),* Zoysia grass (*Zoysia tenuifolia willd),* Green amaranth (*Amaranthus viridius L.),* Red amaranth (*Amaranthus caudatus L.),* and Edible amaranth (*Amaranthus mangostanus L.).* They survived and concentrated a high concentration of cadmium, chromium, copper, nickel and zinc. (Bengao and Cababat, 2014).

Land reclamation procedure

The backfilled areas taken over after completion of dumping involves lot of undulations of the ground, heaps and low lying pockets, leading to rough terrain and water stagnation. These undulations will be removed with the help of CME equipments. Conservation of top soil is removed by using backhole shovel. Then top soil transported and stacked separately by using dumpers at backfilled area. In order to transform the dump soil into fertile land for ornamental gardening, soil inputs viz. organic amendments(saw dust, lignite dust, composts, vermicompost, pressmud, FYM),chemical reclamation(urea, super phosphate, potash, gypsum, and micronutrients like CU, Zn, Mn, MO & B), bio reclamation (Using Bio-fertilizers and VAM fungi, a kind of fungi is found to have beneficial effects on plant growth), utilsation of fly ash in reclamation (lignite fly ash contains plant nutrients like Ca, Mg, K, P, S, Cu, Zn,

Mn, Fe, B, Mo etc.) and the reclamation using lignite based humicacid could be used effectively for reclamation and revegetation process (Cheiner,1983 and Karuppaiah *et al*.,2001)

Soil fertility and management of top soil for gardening

The area reclaimed for gardening or other intensive use will normally require maintenance of the fertilizer programmed. Minespoil will require significant fertilizer element applications for the establishments and maintenance of any plant community. Organic matter is the major source of nutrients such as nitrogen and available P and K in unfertilized soils (Karuppaiah,1999). There are also certain amendments which have shown promise for improving spoil as a plant growth medium. Saw dust has been shown to increase the survival rates of certain trees, herbs and shrubs. The addition of woodchips to bare spoils was second only topsoil application for increasing plant establishing and their growth. When wood residue had been used as a spoil amendment along with N increases the effects of fertilizers such as N, P, K or amendments with gypsum increases the level of soluble salts and the maintenance of a vigorous legume component within the plant community is critical reclamation success (Sheoran*et al.,* 2010).Utilisationof FYM, pressmud, composts, flyash, humicacid, biofertilizers and inorganic nutrients were found to be the best for growing horticultural crops in the lignite mine spoil (Karuppaiah and Manivannan, 2005).

Bio-restoration of mine spoil through ornamental and landscape gardening

Productivity of degradable land is restored by revegetation practices. The roots of vegetation stabilize dump through controlling soil erosion, evapo-transpiration, restoring soil fertility, microbial activity, improving the micro climatic conditions and hence re-vegetation of waste or degraded is an ecofriendly option (Rai *et al*.,2011).The researchers throughout the world on minespoil emphasizes that there is a natural abundance in genetic diversity to come up well even under mine stress. The wide range of native species such as annuals, biennials, herbs, grasses, shrubs, xeriscape plants, water loving plants, small and big trees, climbers and creepers were found to be suitable for mine stress as such by many researchers which could enable the landscape architect to find reliable plants for almost any problem sites. Many are suitable for landscape work from small scale gardens with living components viz., lawn or turf, flowering annual, topiary, trophy, shrubs, shrubbery borders, hedges, edges, ornamental trees with functional, aesthetical, recreational and ecological purposes, water garden plants, palms., etc to the large scale, from single specimen to species suitable for hydroseeding and natural reclamation processes. In addition to this, in a small garden, the garden could be garnished very well with epiphytes, hanging baskets, trophy, potted plants, arches, pergolas and with other non-living enrichments by using appropriate techniques on selection of native plants and mild addition of amendments, fertilizers and biofertilizers. The natural water ponds could be covered with floating wild azola, algae, etc both for aesthetic and reclamation purposes. Inclusion of flora with fauna such as butterflies, bees and other ornamental animals will enhance the bioaesthetic values of the area which could attract nearby area people thereby improve the socio-economic and ecological value of the minespoil site.

In a large area of undulated overburdens, an arboretum could be developed with the native species with slight addition of amendments. The single native specimen species to multiple species could be planted in the slopes of overburden dump in an ornamental colour pattern of monochromatic, analogue or contrast to express the beautiful landscape flowering view. Functional trees with economical value could very well be included. Trees provide contrasts of colour, texture and form in a built environment, introducing the shapes and colours of nature into the man-made geometric patterns. Changing colour with the passing of the season, trees provide endless variety, delight, fresh greenery blossoms, ripening fruits, seeds and colour. Trees often have particularly evocative qualities or associations. Arboratum have more than simply a visual appeal. There is another aspect of considerable importance such as pollution control and partly psychological in its effect in the mining industrial area. There can also be no doubt that in general terms the surrounding spoil will be improved by the arboretum.

A large stretch of grass growing could be done by selecting suitable grasses and addition of amendments and top dressing of fertilizers and top soil. This will improve the landscape value of the minespoil overburden, reduce the spoil erosion and the particulate dust pollution in the surroundings of minespoil area.

Xeriscaping which means water conserving or no water requiring landscape by the selection of appropriate plants such as xerophytes or water conserving techniques could be used effectively to reclaim and revegetate the minespoil with the improvement in aesthetic, functional, recreational and ecological values. Legumes are known for its easy establishment and soil improvement along with their beautiful flowers, foliage and variety of form, texture, colour and growth habits. Hence , native legumes can be used as a ground cover, flowering annuals, hedge, edge, shrub, shrubbery, climber and creepers., etc in the ornamental and landscape gardening of minespoil.

Reclaimed minespoil index

Reclaimed mine spoil index (RMSI)is used for screening of tree spices for reclamation of coal mine degraded land .Principle component analysis (PCA) was employed to derive RMSI.RMSI values were validated by regression analysis with the plant growth parameters, such as, aerial height, diameter at breast height and canopy cover .Tree species in coal mining areas had diverse effect on their respective rhizosphere soil, which could directly or indirectly determine the survival and performance of the planted tree species in degraded coal mining areas. Principle component analysis of soil CO_2 flux, coarse fraction, dehydrogenase activity and organic carbon are the major factors which influence the overall development of soil health. Over all, these physico-chemical and biological properties can be considered biomarkers of the reclamation status and quality of soil. Tree species with higher RMSI values could be recommended for re-vegetation of degraded coal mining area. Tree species could be grouped as: high RMSI (>0.500) – *Cassia siamea*and *Dalbergia sissoo,* moderate RMSI: (0.300-0.499) – *Leucanea leucocephala, Acacia auriculiformis* and *Gmelina arborea;* and low RMSI (<0.300) – *Terminalia arjuna. C. siamea, D. sissoo, L. leucocephala, G. arborea* and *A. auriculiformis* with high to medium RMSI values are preferable for reclamation of degraded sides (Mukopadhyay *et al.,* 2013).

Formula

RMSI = ∑ WiSi

W = Principle component weighting factor

S = Indicator score for and each variable

n = No. of variables in the MDS (Minimum Data Set) (Mukopadhyay*et al.,* 2013).

CONCLUSION

Mining activity generates a large quantity of solid wastes in the form of overburdens. These wastes cause major environmental issues in different locations throughout the world. One of the greatest difficulties encountered in carrying out landscaping and planting schemes on spoiled land is the hostility of the ground material towards plant growth. Consequently, such schemes often demand drastic treatments of the planting media in order to improve their growth potential. A further difficulty is that spoil conditions are extremely variable and each site posing its own special problems. There is, therefore, no universally applicable treatment and it is necessary to carryout special investigations. The information gained is then used to devise suitable plant selection and management techniques for landscaping in the minespoil.

It is now recognized that selection of plant species suitable to the minespoil from grasses upto a higher trees, inclusion of native species and the minimum amendments usage techniques could facilitate to select suitable plants for various components of the ornamental and landscape gardening. Legumes, grasses, native trees and other plants can efficiently be used for landscaping along with landscaping techniques such as arboretum, utilization of natural bonds, xeriscaping, hydroseeding and bioesthetic planning to improve the landscape value of the minespoil overburden, reduce spoil erosion and the particulate dust pollution in the surroundings of minespoil area.

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Table 1. Vegetation in the minespoil

Plant species	Minespoil type	Authority
Grevillea pteridifolium, Eucalyptus camaldulensis	Bauxite mined area in central India	Chaturvedi, 1983
Acacia spirobis, Casuarina collina	Nickel ore minespoil in New Caledonia, USA	Chaturvedi, 1983
Ipomoea carnea, Agave americana	Minespoil of Uttar Pradesh, India	Dadhwal and Kaityar, 1985
Saliretetrasperma, Vitex negundo, Ficus rumphii, Ipomoea carnea, Pueraria hirsute, Sapium insignia, Erythrina suberosa.	Abandoned mine area of Sahastradhara Uttar Pradesh, India.	Dhyani*et al.*, 1985
Eucalyptus hybrida, Dalbergia sissoo, Acacia nilotica, Pongamia pinnata.	Coal minespoil, Himachal Pradesh, India.	Ramprasad and Shkula, 1985.
Pennisetum purpureum, Saccharum spontaneum, Vitex negundo, Rumex hasatus, Minrobahimalayana, Buddleia aseatica, Dalbergia sissoo, Acacia nilotica, Leucaena leucoceplala, Salix tetrasperma.	Maldeota minespoil, Himachal Pradesh, India.	Soni*et al.*, 1986.
Pinus pinaster, Populus rigra var. Pyramidalis	Lignite minespoil, Istanbul.	Kantarci, 1989.
Walnut, Oak, apricot, horse chestnut, hastlenut.	Coal minespoil, Ukraine	Logginor, 1989
Rabina pseudo-acacia, Eucalypus hybrida	Himachal Pradesh minespoil, India	Sharma and Geyer,1990
White pine, Virginia pine, Black walnut, Black alder, Olive	Minespoil of USA	Thomas and Diane, 1990
Eucalyptus tereticornis, E.camaldulensis, Emblica officinalis, Dalbergia sisoo, Madhuca latifolia, Acacia spp	Coal minespoil, Shahdol, MP, India	Ramprasad *et al.*, 1991
Acacia spp.	All mine spoil and waste lands, India	RamPrasad, 1992
Acacia, Leucaena, Eucalyptus, Albizzia and Pinus	Maldeota Himachal Pradesh, India	Soni*et al.*, 1992
Casuarina equisetifolia	Tin minespoil, Zimbabwe	Thaiustsa, 1992

Leucaena leucocephala, Bauhinia retusa, Pennisetum purpureum, Eulaliopsis binata, Chrysopogen fulvus	Limestone minespoil of Uttar Pradesh, India.	Dadhwal andBijendra Singh., 1993
Maclura pomifera [Pinus taeda], Quercus acutissima	Open cast lignite minespoil, Louisiana, *USA*	Haywood *et al.*, 1993
Cajanus cajan, Phaseolus mungo	Coal minespoil, Singrauli, MP, India	Jha and Singh, 1993
Sesbania grandiflora, Leucaena leucocephala, Acacia nilotica	Iron minespoil, Orissa, India	Thatoi*et al.*, 1995
Trema politoria	Phosphate minespoil, UP, India	Vasistha*et al.*, 1995
Cassia siamea, Derris indica, Dalbergia sissoo	Coal minespoil, India	Mehrotra, 1996
Tamarindus indica, Pongamia pinnata, Azadirachta indica	Calcareous minespoil, Madukkarai, TN, India	Paulsamy*et al.*, 1996
Pennisetum pedicellatum	Coal mine spoil, Singrauli, MP, India	Singh *et al.*, 1997
Albizzia procera	Coal minespoil, MP, India	Singh *et al.*, 1997a
Sesleria varia, Lolium perenne, Festuca rubra, Festuca ovina, Dactylis glomerata, Poa pratensis, Hippophae rhamnoides, Elaeagnus angustifolia, E.commutata	Potassium minespoil, Germany	Heinze and Liebmann, 1988
Alnus rubra, Alnus glutinosa	Coal minespoil, Scotland	Nriewan *et al.*, 1999

RESEARCH ARTICLE

Hypoglycemic and Antioxidant Activity of Traditionally used Polyherbal Drug to Treat Diabetes in Kolli Hills

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ABSTRACT

The purpose of this study was to look into the anti-diabetic mechanisms of polyherbal plant extracts *(Andrographis paniculata, Andrographis alata, Adhatoda zeylanica, Gymnema sylvestre, Syzygium cumini and Justicia glabra)* in rats with streptozotocin-induced type 2 diabetes. The anti-diabetic effect of polyherbal drug was evaluated by test hypoglycemic activity and antioxidant activity. To determine the antioxidant effects of polyherbal drug, hepatic and renal antioxidant markers such as superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx), reduced glutathione (GSH), and lipid peroxidase (LPO) were studied. Type 2 diabetes had a significant impact on these indicators, but oral administration of the polyherbal drug significantly improved them. The results indicated that there were no significant changes in hypoglycemic activity of various extracts of polyherbal medication treated rats at varied dosages, and it was determined to be within the normal range. The antioxidant activity of polyherbal drug extracts in aqueous, ethanol, ethylacetate, and chloroform extracts in STZ-treated rats indicated that the level of antioxidant enzymes was acceptable.

Keywords: Polyherbal drug, Streptozotocin induced diabetes, Hypoglycemic activity, Antioxidant activity.

INTRODUCTION

The traditional and rural people of India have saved a major portion of traditional knowledge, which is passed down through generations by hearsay and is widely used for the treatment of common diseases and disorders. Plants are the foundation of scientific medicine's understanding [1]. For thousands of years, nature has been a source of therapeutic plants, and an incredible number of modern medications have been separated from them, many of which are based on their usage in herbal medicine [2]. Secondary metabolites are organic phytochemicals with significant structural diversity that medicinal plants can create in enormous quantities. Some of these secondary metabolites come from various plants. There has been a remarkable surge in the usage of plant-based health products in both developing and developed nations in recent years, leading in an exponential expansion of herbal goods internationally [3]. The most prevalent endocrine disorder is diabetes mellitus. More than one-fifth are Indians are affected with diabetes and the International Diabetes Federation declared India is the "Diabetic Capital of the World." Synthetic anti-diabetic drugs can have substantial adverse effects and are not safe for human use. Given the risks related with synthetic drugs, traditional antidiabetic botanicals can be investigated as a safer, less expensive, and more effective alternative [4]. Furthermore, following the World Health Organization's recommendation on diabetes mellitus, research on hypoglycemic medicines derived from medicinal plants has grown more important [5]. Diabetes is a major global health issue that predisposes to significantly increased cardiovascular mortality and substantial disease due to the development of nephropathy, neuropathy, and retinopathy [6, 7]. The present study was conducted to explore the hypoglycemic and antioxidant activities of a polyherbal medication, as well as its effect on Streptozotocin-induced diabetic rats.

MATERIAL AND METHODS

Collection of plant

Whole plant of *A. paniculata, A. alata, G. sylvestre and J. glabra, leaves of A. zeylanica, bark of S. cumini* were collected from Kolli hills, Namakkal district, Tamilnadu. They were brought to the laboratory, cleaned with tap water, dried under shade and finely powdered using mechanical grinder.

Preparation of extracts

The Polyherbal drug was prepared by mixing equal quantity of whole plant *of A. paniculata, A. alata, G. sylvestre and J. glabra, leaves of A. zeylanica, and bark of S. cumini* powder. Then it was extracted by cold extraction method using different solvents (aqueous, ethanol, ethylacetate and chloroform) with different polarity. They were concentrated to a dry mass by vacuum evaporator and stored separately in desiccator until use.

Induction of diabetes

Diabetes mellitus was induced by single intraperitoneal injection of streptozotocin (50 mg/kg of body weight in double distilled water) to overnight fasted albino rats. The diabetes was assessed in streptozotocin-induced rats by determining the blood glucose level, only after 24 hours of injection of streptozotocin. The rats with fasting blood glucose level above 250 mg/dl were considered as diabetic rats and they were selected for the experimental studies.

Experimental set up for antidiabetic evaluation

In this experiment, the healthy adult male albino rats weighed about 150 to 200 g were used. They were divided into seven groups of 3 rats each and caged in separate cages. Group-I rats were considered as control rats and given normal pellet feed and water. Group-II rats were diabetic control rats (induced diabetes by STZ) given only normal feed and water throughout the experimental period (35 days). Group-III rats were orally given glibenclamide, standard synthetic drug at a dose 5 mg/kg body weight/day for 35 days. Rats of group-IV to group-VII were treated with different extracts of polyherbal drugs at a dose of 250 mg/kg body weight/day for 35 days.

Hypoglycemic activity of polyherbal drug

Weekly, blood glucose level was estimated in drug administered rats and control rats to know whether polyherbal drug possess hypoglycaemic effect or not. A few drops of blood were collected from tail vein and add a drop on IVD strip of glucometer (AP+Plus blood glucose monitoring system, Manufactured by Major bio system Corp. Taiwan) and noted value as blood glucose level. Extract, which reduced fasting blood glucose level in the rats below 60 mg/dl was considered that extract possessed hypoglycaemic effect.

Evaluation of antioxidant activity

Antioxidant activity of the polyherbal drug extracts was evaluated by analysing abnormalities in superoxide dismutase level [8], catalase level [9], GSH level [10], GPx level [11] and lipid peroxides level [12] in liver, kidney and pancreas of diabetic experimental rats and that were compared with normal rats.

Statistical analysis

Values were represented as Mean ± Standard Error. To compare the means of different experimental groups with normal groups, Analysis of Variance (ANOVA) (both one and two way) was performed at necessary places. The post hoc test (Student-Newman Keuls test; SNK) was performed to investigate the influence of the drug on various biochemical parameters in the extract treated rats. All statistical analyses were performed by using windows-based SPSS package (Statistical Package for Social Sciences/Statistical Product and Service Solutions).

RESULTS

Hypoglycemic effect of polyherbal drug

Weekly blood glucose level and per cent changes in blood glucose level in the polyherbal drug treated rats are shown in Table 2 and Figure 1.

Aqueous extract of polyherbal drug

The control rats and the extract treated rats showed normal blood glucose level throughout the experimental period. No significant difference was observed in the mean blood glucose level among different experimental groups but the mean blood glucose level exhibited significant difference among the weeks of the experimental period ($p<0.005$). The mean blood glucose level of week IV was significantly differed from other experimental groups ($p<0.05$). The mean blood glucose level of week wise per cent change showed slight up and down trend throughout the experimental period. However, no significant difference was observed among different groups and different weeks of the experiment ($p>0.005$).

Ethanol extract of polyherbal drug

There was no significant difference among the different groups of rats ($p>0.005$) and no significant difference among the different weeks of the experiment. The week wise percent change in blood glucose of the extract treated rats and control rats showed an increased and decreased trend in the alternative weeks throughout the experimental period. But the percent change of blood glucose level showed no significant difference among the different groups and weeks of the experiment ($p>0.05$).

Ethylacetate extract of polyherbal drug

No significant difference was observed among the different groups and different weeks of experimental rats ($p>0.005$). Week wise percent changes in blood glucose showed high fluctuations throughout the experimental period among the different groups of the experimental rats. However, no significant difference was observed among the groups ($p>0.005$) but it showed significant difference among different weeks of the experiment ($p<0.005$).

Chloroform extract of polyherbal drug

The week wise percent change of blood glucose showed up and down trend, which also showed no significant difference among the different groups and different weeks of the experiment ($p>0.005$). The results showed that no remarkable changes in blood glucose level of various extracts of polyherbal drug treated rats at different doses and it found in the normal range.

Antioxidant activity of polyherbal drug on STZ induced diabetic rats

The antioxidant activity of polyherbal drug extracts in STZ induced diabetic rats was evaluated by analyzing the levels of SOD, CAT, GSX, GPx and LPO in pancreas, liver and kidney of STZ induced diabetic rats (Table 1). The mean SOD levels in untreated diabetic rats were significantly lower (13.9 ± 0.99 µm of epinephrine oxidized/mg protein) than control rats (21.9 ± 0.99 µm of epinephrine oxidized/mg protein). After the treatment of glibenclamide, it was restored the loss of SOD in diabetic rats. Similarly, the polyherbal drugs extracts increased the levels of SOD in diabetic rats. Among the extracts, ethanol extract highly increased the level of SOD in liver. The same trend was observed in SOD level in kidney of polyherbal drug extracts and glibenclamide treated rats. However, in pancreas SOD level was highly increased by extract treatment in the STZ induced diabetic rat. There were significant differences observed among the SOD level of liver, kidney and pancreas of different groups ($p<0.005$). Mean level of CAT decreased in untreated diabetic rat (53.0 ± 2.42µm of H2O2 oxidised/min/g tissue) as compared to control rats in liver and this was increased after administration of glibenclamide and different extracts of polyherbal drug. Similar observations were made in the CAT content in kidney and pancreas of untreated diabetic rat, glibenclamide and polyherbal drug extracts treated rats. SNK test showed high decrease ($p<0.05$) of CAT level in liver of untreated diabetic rats when compared to other groups. The same results showed in CAT content of kidney and pancreas of untreated diabetic rats.The untreated diabetic rat showed a reduction in GSH level as compared to control rats. However, treatment of glibenclamide to diabetic rats increased the low level of GSH in liver to normal level. Similarly, after administration of polyherbal drug extracts recovered the loss of GSH level in liver of STZ induced diabetic rats. Among the extracts, ethanol extract of polyherbal drug increased highly the level of GSH in liver. There was a significant difference among different groups of rats ($p<0.005$).

The STZ induced diabetic rat showed a reduction in GPx level in liver (0.7 ± 0.07µg of glutathione oxidized/g tissue), kidney (0.5 ± 0.007 µg of glutathione oxidized/g tissue) and pancreas (0.7 ± 0.07 µg of glutathione oxidized/g tissue) when compare to those of control rats (1.1 ± 0.02 µg of glutathione oxidized /g tissue, 1.6 ± 0.09 µg of glutathione oxidized /g tissue and 1.6 ± 0.05 liver, kidney and pancreas respectively). However, after the administration with glibenclamide, the GPx levels in liver, kidney and pancreas were increased. Similarly, the GPx level of those organs was increased to normal level after the treatment of different extracts of polyherbal drug. The SNK test revealed that STZ injection significantly ($p<0.005$) reduced the GPx level in all organs when compared to control. Further, it showed significant increase in GPx level after continuous treatment with polyherbal drug extracts and glibenclamide. The mean LPO content (37.8 ± 5.88 nm of MDA/g tissue; 33.3 ± 3.84 nm of MDA/g tissue and 44 ± 0.14 nm of MDA/g tissue for liver, kidney and pancreas respectively) had increased in untreated diabetic rat after intraperitoneal injection of STZ compared to control rats. However, they were decreased to the normal level only after treatment of glibenclamide and polyherbal drug extracts treatment. Results revealed that the treatment of ethanol and ethylacetate extracts of polyherbal drug recovered abnormal level of antioxidant enzymes to the acceptable level.

DISCUSSION

Hypoglycemic drugs of plant origin used in traditional medicine are significant, according to WHO recommendations. These plants' anti-hyperglycemic benefits are related to their capacity to restore pancreatic cell function by increasing insulin production or decreasing glucose absorption in the intestine. Nowadays as result, herbal medicine therapy protects cells while also smoothing out glucose fluctuations [13]. The use of streptozotocin (STZ)-induced hyperglycemia as an experimental model to research hypoglycemic drug action has been recognised

[7]. Hypoglycemic activity of test herbal drugs in normal rats several plants reduced the normal blood glucose level. The hypoglycemic effect of the plants is largely due to its phytosterols and/or sterolin content [14]. The control rats and the ployherbal drug extracts treated rats showed normal blood glucose level throughout the experimental period. Even though blood glucose level exhibited significant differences ($p<0.005$) among the different groups of rats, those levels did exceed the normal blood glucose level. These results indicate that the test herbal drug did not produce hypoglycemic state in the normal rats. Thus, 250 mg/kg b.wt. dose of aqueous, ethanol, ethylacetate and chloroform extracts of polyherbal drug was selected for antidiabetic evaluation study.

Antioxidant activity of polyherbal drugs in STZ induced diabetic rat

Diabetic animals showed decreased activity of the key antioxidant enzymes viz. SOD, CAT and GPx, which play an important role in scavenging the toxic intermediates of incomplete oxidation. STZ treatment causes significant increases in lipid peoxidation and nitric oxide generation, and decreases antioxiadant enzyms such as catalase, Glutathione peroxidase, and superoxide dismutase activities as well as pancreatic insulin contents. Oxidative stress in diabetes mellitus coexists with a decrease in the antioxidant status [15], which can increase the deleterious effects of free radicals. Hyperglycemia stimulates auto-oxidation of lipids and glycation of protein or glucose, leads to the formation of oxygen (ROS = Reactive Oxygen Species) and nitrogen (RNS= Reactive Nitrogen Species) free radicals. Mitochondrial leakage of these ROS is the main cause for oxidative damage [16, 17]. Mitochondria are the energy reservoir of the cell and the damage inflicted in mitochondria would ultimately result in the reduction of energy production and thereby leading to cell death [18]. Sub cellular membrane, associated with thiol bearing enzymes, represents sensitive sites for detoxification causing perpetuation of cellular function [19]. Reactive oxygen species can themselves reduce the activities of antioxidant defense mechanism. The antioxidant pool is highly aggravated in hyperglycemia due to persistent challenge by ROS [20,21]. Recent findings have suggested that the generation of ROS or RNS leads to oxidation of lipids and proteins which resulted in diabetes related complications [22]. Oxidative atmosphere in cells is also created by the impairment in functioning of endogenous antioxidant enzymes namely superoxide dismutase (SOD), glutathione peroxidase (GPx) and catalase (CAT). GPx, CAT, SOD and GR are known to be inhibited in diabetes mellitus as a result of nonenzymatic glycosylation and oxidation [23]. Under normal conditions, mitochondria possess an efficient biochemical defense mechanism to neutralize the effect mediated by ROS. This system is composed of GSH, glutathione peroxidase, glutathione reductase, superoxide dismutase, NADP dehydrogenase (NADPH), vitamin E and C [24]. Oxidative stress can occur under conditions when oxygen radical production is greater than the detoxification capacity of the cell [25, 26]. The key antioxidants (SOD, CAT and GSH) show decreased activity with the increased lipid peroxidation. Growing evidence indicates that as a result of hyperglycemia oxidative stress is increased in diabetes due to overproduction of reactive oxygen species (ROS) and decreased efficiency of antioxidant defences through enzymatic and non-enzymatic components [27, 28].

Reduced activity levels of SOD and CAT in the liver and kidney tissues have been observed in diabetic rats, and this activity may result in a number of deleterious effects caused by the accumulation of superoxide radicals (O^{2-}) and hydrogen peroxide (H_2O_2) [29]. The antioxidant status in diabetes has been reported to decrease plasma or tissue concentrations of superoxide dismutase (SOD) and catalase (CAT) in both diabetic patients and diabetic animals [30, 31]. In the present study, the level of SOD levels in liver, kidney and pancreas; CAT levels in liver, kidney and pancreas were decreased in STZ induced diabetic rats. These adverse changes were reversed to near normal values in polyherbal extracts treated rats as well as glibenclamide treated rats. Reduced glutathione (GSH) is most abundant and present in all mammalian cells. The depletion of GSH and GST promotes generation of ROS and affecting functional as well as structural integrity of cell and organelle membranes. GSH is a major non-protein thiol in living organisms; this plays a central role in coordinating the body's antioxidant defence process. GSH is the first line of defence against proxidant status [32]. GSH levels represent increased utilization due to oxidative stress [33]. Treatment with polyherbal extracts to STZ induced diabetic rats get better in the levels of GSH (in liver, kidney and pancreas) towards close to the control level. Protein glycation and glucose auto-oxidation can generate free radicals that catalyze the lipid peroxidation (LPO). The increase of free radicals in diabetic condition is may be due to the increased lipid peroxidation (LPO) and the damage to antioxidant defence system[34]. Increased lipid peroxidation (LPO) under diabetic condition could be due to increased oxidative stress in the cell as a result of depletion of

antioxidant scavenger systems. A notable increase in lipid peroxidation in the liver, pancreas and kidney was observed in diabetic rats. Earlier studies have reported that there was an increased lipid peroxidation in liver, kidney and brain of diabetic rats [35, 36]. This may be because the tissues contain relatively high concentration of early peroxidizable fatty acids. In the present study, polyherbal drug extracts treatment enhanced mitochondrial enzymatic antioxidant activity and suppressed lipid peroxidation. Thus, these polyherbal drug extracts have the capacity to scavenge free radicals directly or interfering with generation of free radicals. Inhibitory activity effects of these extracts on oxidative damage may be attributed to the suppression induced peroxidation [37]. Several plant-derived phenolic compounds, such as quercetin and other flavonoids, may be successful target antioxidants to treat these conditions. Quercetin, diosgenin and other flavonoids exhibited an antioxidant effect by elevating intracellular GSH, GPx, SOD, CAT, Vit A and Vit E content in both normal and diabetic hepatocytes, nephrons, and pancreatic cells [38]. In vitro, the flavonoid quercetin has been shown to possess antioxidant properties by inhibiting xanthine oxidase activity [39] and scavenging radical species such as superoxide anion, hydroxyl radical, and peroxynitrite [40, 41]. Thus, the results exhibited that polyherbal drug extracts have potent antioxidant activities in STZ induced diabetic rats.

CONCLUSION

The present study confirms the effects of an aqueous, ethanol, ethylacetate and chloroform extract of polyherbal drug possess significant hypoglycemic and antioxidant activity in streptozotocin induced diabetic rats.

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Table 1: Effect of polyherbal drugs on antioxidant enzymes of STZ induced diabetic rats. Values in the parantheses are range of respective mean.

Parameters	Group I (Mean ± SE)	Group II (Mean ± SE)	Group III (Mean±SE)	Group IV (Mean±SE)	Group V (Mean±SE)	Group VI (Mean±SE)	Group VII (Mean±SE)
SOD(L) (µm of epinephrine oxidized/mg protein)	21.9 ± 0.98 (20.3 – 23.7)	13.9 ± 0.99 (12.4– 15.78)	19.5 ± 0.99 (18.1 – 21.4)	15.8 ± 0.68 (14.7 – 17.0)	17.7 ± 0.07 (16.9– 19.2)	14.3 ± 0.99 (12.4–15.8)	15.0 ± 1.35 (12.4 –16.9)
SOD(K)	12.9 ± 0.33 (12.4 –13.5)	10.1 ± 1.30 (7.9 – 12.4)	14.7 ± 0.33 (14.42– 15.3)	12.9 ± 0.88 (11.3 – 14.2)	13.5 ± 0.65 (12.4– 14.7)	13.8 ± 0.25 (13.5–14.3)	13.2 ± 0.39 (12.4 –13.6)
SOD(P)	13.1 ± 0.37 (12.4 – 13.5)	5.6 ± 0.65 (4.5 – 6.8)	8.1 ± 0.73 (6.8 –9.2)	8.5 ± 0.36 (7.9 – 9.14)	9.3 ± 0.95 (8.0 – 11.2)	9.0 ± 0.65 (7.9 – 10.1)	10.3 ± 0.81 (9.0 – 11.8)
CAT(L) (µm of H_2O_2 oxidised/ min/g tissue)	69.1 ± 0.49 (68.4 –70.1)	53.0 ± 2.42 (48.3 – 56.2)	61.2 ± 2.18 (56.9 – 64.1)	62.9 ± 0.18 (62.6 – 63.2)	59.9 ± 1.90 (56.2– 62.5)	60.8 ± 0.98 (59.5–62.8)	62.1 ± 0.25 (61.7 –62.6)
CAT(K)	52.8 ± 0.28 (52.2 –53.2)	41.4 ± 1.90 (38.8 – 45.1)	49.3 ± 0.44 (48.4 – 49.9)	45.4 ± 1.60 (42.7 – 48.3)	48.8 ± 0.90 (47.5– 50.5)	46.9 ± 1.15 (45.1–49.1)	48.5 ± 0.12 (48.3 –48.7)
CAT(P)	44.1 ± 0.30 (43.5– 44.6)	30.6 ± 1.15 (28.5 – 32.0)	42.4 ± 0.19 (42.0 – 42.7)	37.4 ± 2.60 (34.0 – 42.5)	38.8 ± 0.91 (37.2– 40.4)	40.1 ± 0.72 (38.8–41.2)	38.8 ± 0.91 (37.2 –40.4)
GSH(L) (µg/g tissue)	2.6 ± 0.01 (2.6 – 2.7)	1.6 ± 0.07 (1.4 – 1.7)	2.4 ± 0.03 (2.4 – 2.5)	2.0 ± 0.07 (1.9 – 2.1)	2.4 ± 0.05 (2.3 – 2.5)	2.2 ± 0.04 (2.1 – 2.3)	2.0 ± 0.06 (2.0 – 2.2)
GSH(K)	2.2 ± 0.01 (2.1 – 2.2)	1.7 ± 0.08 (1.5 – 1.8)	2.1 ± 0.04 (2.0 – 2.1)	1.9 ± 0.03 (1.9 – 2.0)	2.1 ± 0.03 (2.0 – 2.1)	1.9 ± 0.05 (1.9 – 2.1)	2.0 ± 0.01 (2.0 – 2.0)
GSH(P)	1.0 ± 0.02 (1.0 – 1.1)	0.8 ± 0.04 (0.7 – 0.9)	1.0 ± 0.06 (0.9 – 1.1)	0.9 ± 0.04 (0.8 – 0.9)	0.9 ± 0.03 (0.9 – 1.0)	0.8 ± 0.01 (0.8 – 0.8)	0.9 ± 0.01 (0.8 – 0.8)
GPx(L) (µg of glutathione oxidized/g tissue)	1.1 ± 0.02 (1.0 –1.1)	0.7 ± 0.07 (0.5 – 0.8)	1.2 ± 0.04 (1.1 – 1.2)	1.1 ± 0.09 (0.9 – 1.3)	1.2 ± 0.01 (1.2 – 1.3)	1.0 ± 0.09 (0.8 – 1.1)	1.1 ± 0.09 (0.9 – 1.3)
GPx(K)	1.6 ± 0.09 (1.4 – 1.7)	0.5 ± 0.07 (0.4 – 0.7)	1.5 ± 0.01 (1.4 – 1.5)	1.1 ± 0.06 (1.0 – 1.26)	1.4 ± 0.03 (1.4 – 1.5)	1.4 ± 0.05 (1.3 – 1.4)	1.3 ± 0.08 (1.1 – 1.4)
GPx(P)	1.6 ± 0.05 (1.6 – 1.7)	0.7 ± 0.07 (0.5 – 0.8)	1.5 ± 0.03 (1.5 – 1.6)	1.4 ± 0.05 (1.3 – 1.4)	1.4 ± 0.09 (1.3 – 1.6)	1.3 ± 0.04 (1.3 – 1.4)	1.2 ± 0.05 (1.1 – 1.3)
LPO(L) (nm of MDA/g tissue)	22.0 ±2.34 (19.3 – 26.7)	37.8 ± 5.88 (26.7 – 46.7)	22.2 ± 2.22 (20.0– 26.67)	21.1 ± 4.11 (13.3 – 27.3)	20.2 ± 3.69 (13.3– 26.0)	18.7 ± 2.90 (13.3–23.3)	18.4 ± 2.56 (13.3– 21.3)

LPO(K)	11.5 ± 0.80 (10.0 – 12.7)	33.3 ± 3.84 (26.7 – 40.0)	16.7 ± 1.76 (14.0 –20.0)	20.9 ± 3.58 (14.0– 26.00)	14.7 ± 2.14 (11.3 –18.7)	21.3 ± 0.67 (20.7–22.7)	22.2 ± 0.80 (20.7– 23.3)
LPO(P)	3.5 ± 0.10 (3.3 – 3.7)	4.4 ± 0.14 (4.1 – 4.60)	3.5 ± 0.13 (3.4 – 3.80)	3.9 ± 0.14 (3.7 – 4.2)	3.7 ± 0.06 (3.6 – 3.80)	3.8 ± 0.02 (3.8 – 3.9)	3.9 ± 0.06 (3.9 – 4.1)

*Groups:

I: Control rats

II: Diabetic control rats

III: Diabetic rats treated with glibenclamide

IV: Diabetic rats treated with aqueous extract of polyherbal drug

V: Diabetic rats treated with ethanol extract of polyherbal drug

VI: Diabetic rats treated with ethylacetate extract of polyherbal drug

VII: Diabetic rats treated with chloroform extract of polyherbal drug

Table 2: Effect of different extract of polyherbal drug on hypoglycemic effect in different group of albino rats. Values within the parantheses are range of respective mean.

Extracts	Week	Group I (Blood glucose)		Group II (Blood glucose)		Group III (Blood glucose)		Group IV (Blood glucose)	
		Mean ± SE (mg/dl)	Mean ± SE (% change)	Mean ± SE (mg/dl)	Mean ± SE (% change)	Mean ± SE (mg/dl)	Mean ± SE (% change)	Mean ± SE (mg/dl)	Mean ± SE (% change)
Aqueous	**I**	76.3 ± 2.33 (72– 80)		74.6 ± 5.24 (68 –85)		75.7 ± 2.96 (70 – 80)		71.0 ± 1.73 (68 – 74)	
	II	77.0 ± 4.93 (69 –86)	0.8 ± 5.42 (-5.0 – 11.7)	77.0 ± 2.52 (72 – 80)	3.7 ± 5.06 (-5.9 – 11.3)	81.7 ± 1.45 (79 – 84)	8.3 ± 5.32 (-1.2 – 17.1)	75.3 ± 2.60 (71 – 80)	6.0 ± 1.09 (4.4 – 8.1)
	III	82.0 ± 2.08 (79 – 86)	7.7 ± 9.48 (-8.1 – 24.6)	83.3 ± 2.40 (80–88)	8.3 ± 2.27 (3.8 – 11.1)	78.0 ± 5.69 (70 – 89)	-4.6 ± 5.37 (-11.4 – 5.9)	79.7 ± 1.45 (77 – 82)	5.9 ± 3.36 (2.5 – 12.7)
	IV	81.3 ± 2.72 (76 – 85)	-0.5 ± 5.74 (-11.6 – 7.6)	90.7 ± 4.26 (85 – 99)	8.7 ± 1.93 (6.2 – 12.5)	86.3 ± 4.48 (80 – 95)	12.1 ± 11.31 (-10.1 – 26.7)	91.7 ± 2.03 (88 – 95)	15.2 ± 4.14 (10.0 – 23.3)
Ethanol	**I**	76.3 ± 2.3 (72 – 80)		76.7 ± 3.38 (70 –81)		79.0 ± 2.08 (75 – 82)		77.3 ± 6.01 (69 – 89)	
	II	77.0 ± 4.93 (69 – 86)	0.8 ± 5.42 (-5.0 – 11.7)	72.0 ± 7.23 (60 – 85)	-4.9 ± 13.6 (-24.0–21.4)	78.0 ± 3.21 (72 – 83)	-1.0 ± 5.59 (-12.2 – 5.3)	79.0 ± 7.57 (67 – 93)	3.1 ± 11.69 (-13.4–25.7)
	III	82.0 ± 2.08 (79 – 86)	7.7 ± 9.48 (-8.1 – 24.6)	78.3 ± 2.19 (74 – 81)	10.9 ±11.48 (-4.7 – 33.3)	79.0 ± 2.08 (75 – 82)	1.4 ± 2.53 (-3.6 – 4.2)	82.3 ± 4.26 (74 – 88)	6.3 ± 12.60 (-8.6 – 31.3)
	IV	81.3 ± 2.72 (76 –85)	-0.5 ± 5.74 (-11.6 – 7.6)	74.0 ± 3.21 (68 – 79)	-5.6 ± 2.18 (-8.1– -1.25)	79.3 ± 3.18 (74 – 85)	0.7 ± 6.74 (-9.7 – 13.3)	74.6 ± 2.91 (70 – 80)	-9.1 ± 2.17 (-12.9– -5.4)
Ethyl acetate	**I**	76.3 ± 2.33 (72 – 80)		80.0 ± 1.15 (78 – 82)		85.0 ± 2.65 (80 – 89)		88.0 ± 1.73 (85 – 91)	
	II	77.0 ± 4.93 (69 – 86)	0.8 ± 5.42 (-5.0 – 11.7)	75.7 ± 3.38 (69 – 80)	-5.3 ± 4.71 (-13.7 – 2.6)	74.0 ± 4.04 (66 – 79)	-13.0 ± 2.23 (-17.5– -10.5)	77.7 ± 1.86 (74 – 80)	-11.7 ± 1.32 (-13.2– -9.1)
	III	82.0 ± 2.08 (79– 86)	7.7 ± 9.48 (-8.1 – 24.6)	76.3 ± 3.28 (70 – 81)	0.9 ± 1.85 (-2.5 – 3.8)	78.0 ± 2.00 (74 – 80)	5.8 ±3.27 (1.3 – 12.1)	84.0 ± 2.89 (79 –89)	8.1 ± 1.57 (6.3 – 11.2)
	IV	81.3 ± 2.72 (76 – 85)	-0.5 ± 5.74 (-11.6 – 7.6)	78.0 ± 4.73 (69 –85)	2.9 ± 9.74 (-11.5–21.4)	80.0 ± 5.29 (72 –90)	2.6 ± 6.64 (-10.0 – 12.5)	87.6± 3.76 (81 – 94)	4.5 ± 4.36 (-3.6 – 11.4)
Chloroform	**I**	76.3 ± 2.33 (72– 80)		72.0 ± 4.62 (64 – 80)		74.0 ± 3.61 (69 –81)		81.0 ± 1.53 (79 – 84)	
	II	77.0 ± 4.93 (69 – 86)	0.8 ± 5.42 (-5.0 – 11.7)	73.3 ± 3.53 (68 – 80)	2.9 ± 8.94 (-15.0–12.5)	78.0 ± 3.46 (72– 84)	5.8 ± 5.92 (-3.7 – 16.7)	78.0 ± 2.08 (74 – 81)	-3.7 ± 2.16 (-7.5 – 0.0)

	III	82.0 ± 2.08 (79 – 86)	7.7 ± 9.48 (-8.1 – 24.6)	81.3 ± 3.53 (76 –88)	11.8 ± 9.94 (-5.0 – 29.4)	83.3 ± 3.38 (79 – 90)	7.3 ± 6.68 (-5.9 – 15.4)	76.3 ± 3.53 (71 – 83)	-2.2 ± 2.36 (-5.1 – 2.5)
	IV	81.3 ± 2.72 (76 – 85)	-0.5 ± 5.74 (-11.6 – 7.6)	81.3 ± 3.53 (76 –88)	0.7 ± 8.50 (-13.6–15.8)	79.3 ± 5.81 (70 – 90)	-4.3 ± 9.12 (-13.6 – 13.9)	83.7 ± 2.03 (80 – 87)	9.8 ± 2.51 (4.8 – 12.6)

Groups:

Group I: Control rats

Group II: Extract treated rats with a dose of 125 mg/kg body weight

Group III: Extract treated rats with a dose of 250 mg/kg body weight

Group IV: Extract treated rats with a dose of 500 mg/kg body weight

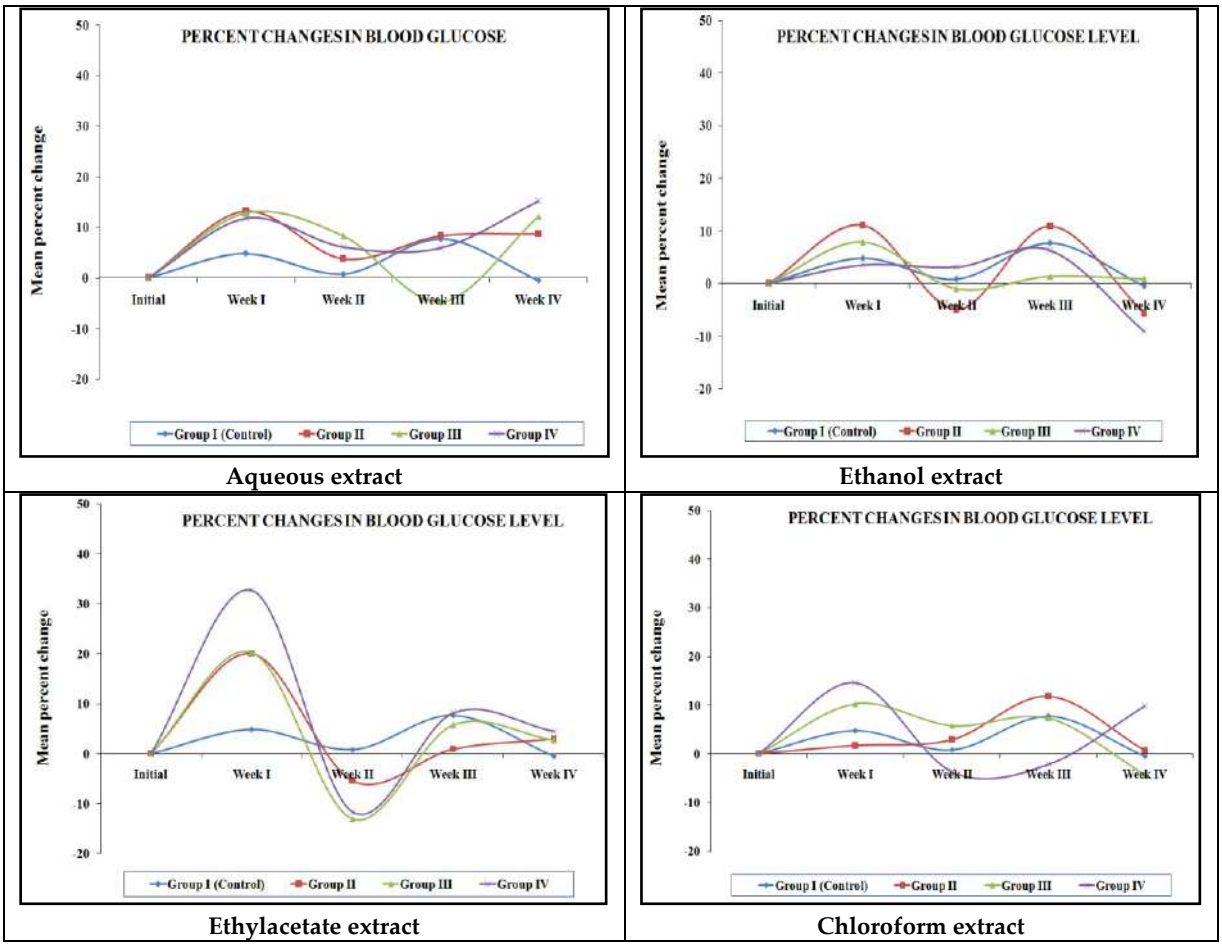

Figure 1: Effect of different extract of polyherbal drug on hypoglycemic effect in different group of albino rats during different weeks of experiment

Group I: Control rats

Group II: Extract treated rats with a dose of 125 mg/kg body weight

Group III: Extract treated rats with a dose of 250 mg/kg body weight

Group IV: Extract treated rats with a dose of 500 mg/kg body weight

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RESEARCH ARTICLE

Authenticated Key Exchange in Distributed Storage System

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ABSTRACT

This paper advises the most ideal way to share the data securely, gainfully and deftly with others in dispersed capacity. The proposed system Key-Aggregate Cryptosystem will create figure text of reliable size with the ultimate objective that disentangling opportunities can be designated on client. By joining a lot of secret keys, the system will make a limited single key. By using this more modest key, client can send others or can be store in a particularly confined secure amassing. In the first place, owner of the data Setup the public system next Keygen computation makes a public or master/secret key. By using this key, client can change plain text over to encode text. Next client will give input as master secret key by Extract work; it will make yield as absolute deciphering key. This created key is safely delivered off the recipient. Then, the client with complete key can disentangle the code message utilizing Decrypt work. The proposed structure will give formal security examination of our arrangements in the standard model and moreover portray other use of our arrangements. In particular, our arrangements give the principal public-key patient-controlled encryption for versatile request, which was now to be known. Dispersed capacity is gaining unmistakable quality lately. In large business settings, there is a rising famous for data reevaluating, which helps the fundamental organization of corporate data.

Keywords: Key-Aggregate Cryptosystem, mystery key, Distributed storage.

INTRODUCTION

To execute how to Securely, really, and deftly share data with others in conveyed capacity. Data sharing is a critical convenience in circulated capacity. For example, bloggers can permit their allies to see a subset of their private pictures; an undertaking could give their delegates permission to a piece of sensitive data. The troublesome issue is the way to effectively share encoded data. Clearly, clients can download the encoded information from the limit, disentangle them, then, send them to others for sharing, yet it loses the value of appropriated stockpiling. Clients should have the choice to relegate the entry honours of the offering data to others to the objective that they can get to this data from the server clearly. It chips away at the Security of the Data Shared. It Improves the Traceability of data during Investigation process. Works on the Data Deletion in the event that there ought to be an event of bothersome Situations.

PROBLEM DEFINITION

In a run of the mill residency scattered enlisting climate, things become amazingly more dreadful. Information from various clients can be worked with on discrete virtual machines (VMs) however harp on a solitary genuine machine. Information in a genuine VM could be taken by dispatching another VM coresident with the objective one. As to of records, there are a development of cryptographic plans which go in essentially a similar way as permitting an untouchable reviewer to truly explore the accessibility of files to help the information proprietor without spilling anything about the information, or without compromising the information proprietor's secret. Also, cloud clients surely won't hold the sincere feeling that the cloud server is working reasonably to the degree course of action. A cryptographic game-plan, for instance, with displayed security depended upon number-hypothetical suspicions is really engaging, at whatever point the client isn't completely content with confiding in the security of the VM or the legitimacy of the specific staff. These clients are persuaded to scramble their information with their own keys prior to moving them to the server.

EXISTING SYSTEM

The solidified encryption framework has been proposed to scramble the information before re-appropriating. To extensively more possible assertion information security, this framework makes the head undertaking genuinely address the issue of maintained information De-duplication. Express filename considering the differential benefits of clients are in like way made a point to be in copy check record name brand name the affirmed information. It what's more shows a few new De-duplication updates supporting embraced copy. Information administering in the cloud experiences an astonishing and dynamic different leveled out to connection chain. This in standard conditions can't exist. Standard web structure Uses web relationship for referring to and reactions.

Disadvantages

- Expands the expenses of putting away and communicating ciphertexts.
- Secret keys are typically put away in the sealed memory, which is moderately costly.
- This is a flexible methodology.
- The expenses and intricacies included for the most part increment with the quantity of the unscrambling keys to be shared.

PROPOSED SYSTEM

It makes an unscrambling key as more wonderful as in it licenses interpreting of various ciphertexts, without growing its size. Introducing a public-key encryption which key-all out cryptosystem (KAC) they using AES computation. In KAC, customers encode a message under a public-key, yet also under an identifier of ciphertext called class. That infers the ciphertexts are moreover organized into different classes. The key owner holds a specialist secret called expert secret key, which can be used to isolate secret keys for different classes. Even more altogether, the isolated key has can be a complete key which is just comparably moderate as a strange key for a singular class, yet adds up to the power of many such keys, i.e., the deciphering power for any subset of ciphertext

classes. The proportions of ciphertext, public-key, and master secret key and complete key in our KAC plans are all of predictable size. The public system limit has size straight in the amount of ciphertext classes, but only a tad piece of it is required each time and it might be gotten on demand from gigantic (yet non-secret) appropriated capacity. Previous results may achieve a practically identical property including a reliable size interpreting key, yet the classes need to acclimate to some pre-described moderate relationship. Our work is versatile as in this basic is killed, that is, no unprecedented association is required between the classes.

Advantages of Proposed System

- The assignment of unscrambling can be proficiently carried out with the total key, which is just of fixed size.
- Number of ciphertext classes is huge.
- It is not difficult to key administration for encryption and unscrambling.

RELATED WORK

Client Registration

Here, the enlistment of client with personality ID the group manager arbitrarily chooses a number. Then, at that point, the gathering supervisor adds into the gathering client list which will be utilized in the recognizability stage. Later the enlistment, client acquires a public key which will be utilized for bunch signature age and record unscrambling.

Bunch Registration

There will be a gathering enrollment by giving gathering name and secret key. Administrator is the main individual to make a gathering, User needs to choose the gathering they needs to join for information sharing.

File Access

Record admittance to store and share an information document in the cloud, a gathering part performs to getting the renouncement list from the cloud. In this progression, the part sends the gathering character ID bunch as a solicitation to the cloud. Confirming the legitimacy of the got disavowal list. Document put away in the cloud can be erased by either the gathering supervisor or the information proprietor.

Key Generation

At the point when a client needs to download a document, different clients in the gathering need to give authorization by giving their key. Later consent the client who demand for a document, will get to the record by another client key.

SYSTEM ARCHITECTURE

The above figure shows System Architecture

Advanced Encryption Standard (AES)

The Advanced Encryption Standard (AES) is an encryption computation for getting sensitive yet unclassified material by U.S. Government workplaces and, as a likely result, may eventually transform into the acknowledged encryption standard for business trades in the private region. (Encryption for the US military and other described correspondences is dealt with by free, secret estimations. (DES) and to a lesser extent Triple DES. The specific required a symmetric estimation (same key for encryption and unscrambling) using block encryption (see block figure) of 128 pieces in size, supporting key sizes of 128, 192 and 256 pieces, as a base. It was to be quite easy to execute in hardware and programming, similarly as in bound conditions (for example, in an astute card) and arrangement extraordinary assurances against various attack strategies. The entire decision cycle was totally open to public assessment and comment, it being inferred that full detectable quality would ensure the best examination of the plans. In view of this, in August 1999, NIST picked five computations for more wide assessment.

CONCLUSIONS

The proposed structure will have design Key-Aggregate Cryptosystem for Scalable Data Sharing In Cloud Storage. A customer can bestow data to others in the social affair without revealing character security to the cloud. Additionally, maintains useful customer repudiation and new customer joining. Even more uncommonly, capable customer repudiation can be refined through a public refusal list without reviving the private keys of the extra customers, and new customers can clearly unscramble records set aside in the cloud before their participation. Likewise, the limit overhead and the encryption estimation cost are consistent.

Future Enhancement

As Key age time is high contrasted with encryption and decoding technique, it tends to be additionally decreased to have far superior outcomes.

- The AES Algorithm can measure up to a portion of the other famous symmetric key encryption calculation.
- The calculation can be investigated with different applications like cloud.

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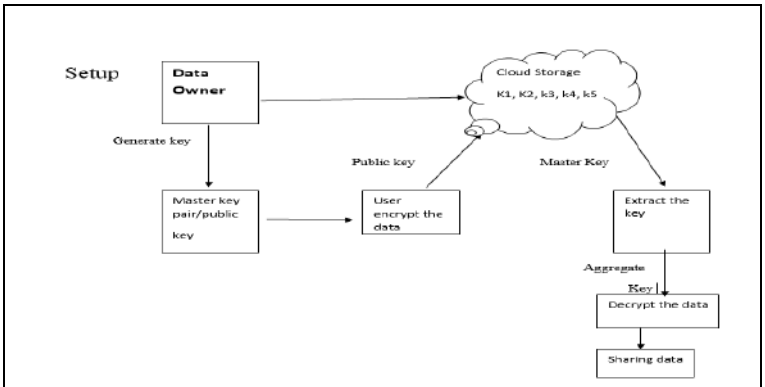

Fig. 1. The above figure shows System Architecture

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RESEARCH ARTICLE

Influence of Seed Treatment with Chemicals and Plant Products on Seed Quality Parameters of Green Gram var. VBN 2

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ABSTRACT

In green gram major one of the most important basic needs for higher productivity is quality seed characterized by higher viability and vigour. An experiments were carried *out* to study the influence of post- harvest treatment on seed quality of green gram seeds *var. VBN 2.* Seeds pelleted with neem leaf powder @ 200g kg^{-1}ofseedperformed better for seed quality characters viz.., germination percentage (90%), root length (14.63 cm), shoot length (20.28 cm) seedling dry matter production (18.12 mg / 10 seedling), vigour index I (3120.53) and vigour index II (614.75) as compared to all other treatments. This may be due to the neem product has anti-oxidant property like acetyl salicylic acid in reducing the lipid peroxidation and protein degradation. It is concluded that green gram var. VBN 2 pelleted with neem leaf powder @ 200g kg^{-1} of seed able to maintain all the seed quality parameters.

Keywords: Green gram, seed quality, seedling, treatment

INTRODUCTION

One of the most important basic needs for higher productivity is quality seed characterized by higher viability and vigour [1]. Green gram (*Vigna radiata* [L.] Wilczek) commonly known as mungbean is one of the most commonly cultivated pulse crop in India. It is an excellent source of easily digestible and high value protein in Indian diet. Area under green gram in India is 3.0 million hectares with an annual production of 1.5 million tones [2]. Nearly 7 per cent of the pulse area is occupied by green gram, which is the third most important pulse crop of India in terms of are a cultivated and production next to chickpea and pigeon pea. Besides their high nutritional value, they have unique characteristics of maintaining and restoring soil fertility through biological nitrogen fixation and thus play a vital role in sustainable agriculture. It occupies a unique position in high agriculture by virtue of the fact that they

constitute a major and the only high protein component to the average Indian diet. In India, one of the most important basic needs for higher agricultural production is quality seeds, characterized by high viability and vigour. Many of synthetic chemical look effective but they are not readily degradable physically or biologically which yield more toxic residues. Hence, the feasible approach is the treatment of seeds with botanicals which are safe, economical, eco- friendly, cheap, easily locally available and non-harmful to seeds, animals and human beings. It will be of immense use to the farming community. Therefore, seed treatment with suitable chemicals and botanicals will reduce the quantitative and qualitative losses besides maintaining quality of seed. Hence, the present investigation was carried out to study the influence of post-harvest seed treatment with plant products and chemicals on quality parameters of green gram.

MATERIALS AND METHODS

The experiments were carried *out* to study the influence of post- harvest treatment on seed quality of green gram seeds *var. VBN 2*. The study was carried out at the Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, Annamalai nagar. The seeds were treated with chemicals and plant products at different dosages to identify their efficacy towards seed quality. Freshly harvested bulk seeds of green gram seeds var. VBN 2 were dried to 8 per cent moisture content and were imposed with the following seed treatments and under ambient condition. T_1 – Control, T_2 - Treatment with Carbendazim @ 2g kg^{-1} of seed, T_3 - Treatment with Prosophis @ 200g kg^{-1} of seed, T_4 - Treatment with Nochi leaf powder @ 200g kg^{-1} of seed, T_5 - Treatment with Pungam leaf powder @ 200g kg^{-1} of seed, T_6 - Treatment with Red soil @ 200g kg^{-1} of seed, T_7 - Treatment with Neem leaf powder @ 200g kg^{-1} of seed and T_8 - Treat, emt with Fly ash @ 300g kg^{-1} of seed. The experiments was formulated by adopting CRD design with three replication and were evaluated for quality characters like speed of germination, Germination percentage, Root length,(cm), Shoot length (cm), seedling dry matter (mg), vigour index I and Vigour index II after treatments. The data from various experiments were analyzed statistically adopting the procedure described by [3] with required replications for laboratory experiment.

RESULTS

Significant differences were observed among the treatments. Significantly highest speed of germination (8.27) was noticed in untreated seeds(T_1). Significantly lowest speed of germination (5.75) was recorded in seeds pelleted with Fly ash @ 300g kg^{-1} of seed (T_8). Significantly higher mean seed germination (90 %) was noticed in seeds treated with neem leaf powder(T_7).Seeds pelleted with neem leaf powder @ 200g kg^{-1} of seed performed better for seed quality characters viz.., germination percentage (90%), root length (14.63 cm), shoot length (20.28 cm), seedling dry matter production (18.12 mg / 10 seedling), vigour index I (3120.53) and vigour index II (614.75) as compared to all other treatments. But untreated seeds recorded lower seed quality characters (Table 1).

DISCUSSION

The seed quality parameters like root length, shoot length, seedling dry matter, vigour index I, vigour index II and speed of germination were significantly higher in the seeds treated with neem leaf powder This may be due to the neem product has anti-oxidant property like acetyl salicylic acid in reducing the lipid peroxidation and protein degradation. Similar findings were made by [4], [5], [6], [7],[8], [9]and [10]. From the above discussion of the results, it is concluded that green gram var. VBN 2 pelleted with neem leaf powder @ 200g kg^{-1} of seed able to maintain all the seed quality parameters. Hence, it is recommended to the farmers for the production of quality green gram seeds.

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Table. 1. Effect of seed treatment with chemicals and organics on the seed quality characters of green gram

Treatments	speed of germination	germination (%)	root length (cm)	shoot length (cm)	seedling dry matter in (mg)	vigour index I	vigour index II
T_1	8.27	82	5.78	9.28	16.25	1230.46	229.60
T_2	6.93	87	10.17	10.53	17.06	1803.34	354.13
T_3	7.25	88	11.34	11.58	17.43	2020.16	401.30
T_4	7.48	85	12.48	10.81	17.34	1994.86	405.02
T_5	7.22	83	11.63	10.67	17.71	1863.57	394.15
T_6	7.16	85	11.61	11.18	17.29	1944.38	395.25
T_7	7.54	90	14.63	20.28	18.12	3120.53	614.75
T_8	5.75	86	11.88	11.26	17.25	1987.84	398.29
SE(d)	0.06	0.23	0.15	0.09	0.003	18.01	3.38
CD(M=0.05)	0.12	0.46	0.31	0.19	0.007	35.85	6.72

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RESEARCH ARTICLE

Study on Food Selection by Asian Elephant (*Elephus maximus*) in Dharamjaigarh Forest Division, C.G.

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ABSTRACT

Historically, Asian elephants were found in northern Chhattisgarh (central India) in the early part of the 20th century they became locally extinct. But since 1988, elephants started migrating from the prime elephant habitat of Jharkhand and Odisha and take refuge in the forest of Chhattisgarh. Hence a study was conducted to find out the food and feeding ecology of the Asian Elephant (*Elephus maximus*) in the Dharamjaigarh Forest Division of Chhattisgarh. For this, vegetation sampling (10X10m) was done in sixteen transects at every 500-meter interval to record the tree species and 16 trails survey (each with 2-4 km length) covering different seasons to record the elephant food plants (direct feeding observation and feeding signs) during 2019-2022. Species diversity, evenness, spatial distribution, and similarity matrix were calculated. A total of 17 species of elephant food species belonging to 10 families were identified as food plants from the reserve (Annexure-I and Table-3). Plant families like Combretaceae, Anacardiaceae, Myrtaceae, Leguminosae, etc. were selected more as the food plant species. Although only 18% of food plants show significant random distribution (out of 77% species random distribution) and most of the food plants seem to have scattered distribution. The relative abundance of the food species consumed by elephants appeared to be on an average of only 0.8 % (SE = 0.3) of the total number of tree species found

in the sampled region. The random distribution and relatively low distribution of food plants might have resulted in crop depredation in the fringe villages of Dharamjaigarh Forest Division, Chhattisgarh, India.

Keywords: Asian elephant, Dharamjaigarh Forest Division, elephant food plants, plant diversity and relative abundance

INTRODUCTION

Food is the essential prerequisite for a creature to get by and keep up with their great well-being. Consequently, a creature should obtain food that contains an adequate number of supplements to satisfy their physiological necessities. The accessibility of food assets and their dissemination design doesn't just influence the physiology of an animal type yet additionally the movement and the living space usage design (Vancuylenberg, 1977) of the untamed life species. The dissemination example of the food plants inside given natural surroundings decides the spatial dispersion of a given animal category (Sukumar, 1990; Sivaganesan and Johnsingh, 1993; Balasubramanian *et al.,* 1995; Animon *et al.,* 1997). This example, at last, decides the populace size of an animal variety in a given region. Species-explicit food decisions and the dispersion example of food assets over the natural surroundings are essential to format a comprehensive methodology for the protection and the board. Studies could help in further developing the environmental quality as well as assessing the living space before starting the species-explicit re-presentation program. Consequently, various umbrella, cornerstone, and lead species (Krebs, 1985) are exposed to study to format an all-encompassing methodology for preservation and the board. During this interaction, taking care of biology is perhaps the best apparatus to comprehend the species-explicit food decision, which will additionally assist with getting the explanation of species-explicit living space selectivity and variety in time portion for different exercises. Several studies were conducted on the food and feeding of Asian elephants by Barnes (1982), Clauss *et al.* (2003), Danquah and Oppong (2006), De Boer *et al.* (2000), Dhakal and Ojha (1995), Hettiarchchi *et al.* (2005), Lihong *et al.* (2007), Mercy (2002), Pradhan *et al.* (2008), Samansiri and Weerakoon (2007), Santra *et al.* (2008), Sivaganesan and Johnsingh (1995), Sukumar (1990), Sukumar and Ramesh (1995) and Vancuylenburg (1977). But none of these studies covered the feeding ecology of the newly established elephant population in Chhattisgarh. Asian elephants were found in northern Chhattisgarh (central India) since historical times, however, in the early part of the 20th century, they became locally extinct. But in 1988, elephants started migrating from the prime elephant habitat of Jharkhand and Odisha into Chhattisgarh and caused extensive damage to life and property (Singh, 2002; Thakur *et al*., 2015). As of now, the fragmented landscapes and remnant forest patches of Chhattisgarh acts as habitat refugee for these elephants. Under such extreme, it is important to conduct a study of food resources and feeding ecology is very important for developing a holistic approach to the conservation of elephants (Bal *et al.,* 2011; Graham et al., 2009; Mudappa and Raman, 2007).

MATERIALS AND METHODS

As the elephants were mostly found in Chhal and Dharamjaigarh ranges under Dharamjaigarh Forest Division, this study covered these two ranges. For studying the feeding ecology, it is necessary to know the vegetation profile first and then the food plant selection. Hence, the vegetation sampling, as well as the feeding selection, was done in Chhal and Dharamjaigarh ranges.

Vegetation sampling

A vegetation survey was done in sixteen transects (8 transects in each forest range). At every 500 meter interval (at 0km, 0.5km, 1km, 1.5kms, and 2kms) of each transects, a 10X10m plot was established for vegetation survey, and a total of 80 quadrats were established. The data further analyzed to calculate the species diversity, evenness, spatial distribution, species-area curve, and similarity matrix were calculated.

Assessment of selection of elephant food plants:

Another 16 trails (each with 2-4 km length) were surveyed 64 times covering different seasons to record the elephant food plants. For this, direct feeding observation and indirect approaches through feeding signs were followed:

Direct observation

In this method, the direct observation of the feeding behavior of specific food plants was recorded.

Indirect method

As the sighting of an elephant inside the forest is very rare, only a few species of food plants were identified through direct observation. Therefore, the presence of all the feeding signs of elephants was recorded concerning species names during the trail survey. In the cases, species name, the status of the sign (old or new), parts eaten (leaf, stem, fruit, flower, bark, etc.), type of plant (full-grown or sapling), and availability of the same species in 10m radius of the food plant was recorded.

RESULTS

Species abundance and diversity

A total of 47 species of 28 families (*Annexure-I*) were enumerated within the sampled area. Among all species Sal (*Shorea robusta*) was dominant with the highest density of 220.3 per Ha followed by Saja (*Terminallia tomentosa*) (76.3%). Only 8 species had a density of more than 10 and the remaining other species had a density of less than 10. Although the spatial distribution of most of the species (73%) was random, only 8 species of them (23%) had statistically significant ($p>0.005$) random distribution. The results show that 27% of species had aggregated distribution, and interestingly 92% of them were significantly aggregated. Out of 16 transects surveyed, the number of species ranged from 12 to 20 tree species with the mean number of species of 16 (SE = 1.1)/transect. The number of individuals ranged from 24 to 67 with the mean number of individuals of 48 (SE = 4.0)/ transect. *Shannon – Wiener's diversity index* (Magurran, 1988) values ranged from as low as 1.07 to a high of 1.30, suggesting a uniform diversity value for all the locations surveyed. The evenness value for the study region is 0.033, and it ranged from 0.06 to 0.09. Fisher's alpha index value ranged from 6 to 13/ transect (Table-1).The species-area curve shows that there is a gradual increase of species and for every 400 m2 plot, an average of 4.1 (SE = 0.9) was noticed. The increase in the number of species was not uniform as an initial increment of 9 species and the increase was stabilized to 2 species. As there was a constant increase of species, the species-area curve for the study region did not stabilize, suggesting a small sample size for species saturation (Fig. 1).The species similarity matrix showed that the locations between Purunga and Rupunga had a similarity of 75.9% followed by Ongana and Purunga (58.6%), and Hati and Purunga (57.4%). However, the least ($\underline{\geq}$10%) similarity was found between Kudekela and Dharamjaigarh (4%) followed by Ongana and Potia (8.5%), Potia and Rupunga (7.7%), Potia and Purunga (5.3), and Ongana and Dharamjaigarh (4.4%) (Table-2). This indicates that the habitats are not uniform.The species similarity shows that four locations had $\underline{\geq}$50% species similarity whereas the remaining areas had only $\underline{\leq}$25% species similarity

Food plants and their availability

A total of 17 species of elephant food species belonging to 10 families were identified from the reserve (Annexure-I and Table-3). Plant families like Anacardiaceae, Burseraceae, Combretaceae, Leguminosae, Moraceae, Myrtaceae, Rhamnaceae, Sapotacceae, Streculiaceae and Ulmaccae were selected more as the food plant species. Although only 18% of food plants show significant random distribution (out of 77% species random distribution) and most of the food plant seems to have scattered distribution. The relative abundance of the food species consumed by elephants appeared to be on average only 0.8% (SE = 0.3) of the total number of tree species found in the sampled region. This random distribution and relatively low abundance of food species may result in wider movement or distribution of elephants in search of food plants. Elephants were observed to be feeding on plant parts such as stem (with twigs), bark, and fruits. Elephants were observed to be consuming 39 species of stems (78%), 25 species of bark (52%), and 11 species of fruits (24 %). They appeared to be selecting more of the stem part of plant species; this selection is evident

from their specific choices of this part individually or along with bark or fruits. After stems, bark appears to be their second choice.

DISCUSSION

Elephants are generalist feeders and have less discrimination than other herbivores towards the consumption of food plants. During the dry season, 70% of an elephant's diet is browse, while in the wet season, grasses make up the major pan of the diet when available (Sukumar, 1989). Previous studies of the feeding ecology of Asian elephants have been carried out in grasslands in Sri Lanka (McKay, 1973; Vancuylenberg, 1977), and in Tropical rain forests in Malaysia (Olivier, 1978) and the Eastern Ghats by Sukumar (1985) had also stated similar phenomenon. As elephants can able to browse and graze on a variety of plants but their proportions vary both in time and space, they are sustained in the forest of Chhattisgarh where a very negligible amount of grasses are there.Previous studies revealed that the majority (68%) of plants consumed by adult Asian elephants belong to seven families: Fabaceae, Poaceae, Malvaceae, Sterculiaceae, Tiliaceae, Palmae, and Cyperaceae (Sukumar 1992). The plant genera most preferred are Acacia, Bambusa, Dendrocalamus, Arundo, Ficus, Musa, Dalbergia, Mallotus, Saccharum, and Themeda. Elephants were found to consume a variety of plant species and their diet mainly consisted of fifty (50) plant species in Rajaji National Park in Uttarakhand, India (Joshi and Singh, 2008). Studies conducted by Baskaran *et al.* (2010) recorded 83 plant species as the food plants of elephants of which 59 were browsing species (trees, shrubs, herbs, and bamboo), and the rest (24) were grass species. Among the 59 browse species, *Acacia intsia*, bamboo spp. and *Kydia calycina* were the most important diet. On the other hand, the study conducted in southern India pointed out that elephants consumed at least 112 plant species, and 85% of their diet consisted of only 25 species (Sukumar, 1990). In Dharamjaigarh Forest Division, though there were less number of food plants available their dispersion has made the territory appropriate for elephant refuge. However, the suitability of the habitat depends on the regionally consistent presence of certain plant taxa in elephant diets (plant availability, distribution across habitat types, and plants' macro-and micronutrient content, influencing plant selection by elephants (Oliver 1978). The food consumed in the wild is low in nutrients and high in fiber (John and Subramanian, 1991). Hence, elephants subsidize their daily food requirement by raiding crops in Dharamjaigarh Forest Division.

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Conflict of interest

The authors declare that they have no conflict of interest.

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Table 1: Species diversity, richness, and evenness

	Hati	Ongana	Purunga	Kudekela	Potia	Dharamjaigarh	Chhal	Rupunga
No of Species	19.0	16.0	20.0	13.0	12.0	12.0	20.0	17.0
No. of Individuals	42.0	47.0	52.0	40.0	24.0	43.0	67.0	56.0
Shannon Hmax.	1.28	1.20	1.30	1.11	1.08	1.07	1.30	1.23
Evenness	0.07	0.08	0.07	0.09	0.09	0.09	0.06	0.07
Alpha	13.37	8.55	11.90	6.69	9.55	5.52	9.65	8.30

Table 2: Similarity Matrix for study locations

Locations	Hati	Ongana	Purunga	Kudekela	Potia	Dharamjaigarh	Chhal	Rupunga
Hati	*	42.7	57.4	53.7	21.2	18.8	33.0	51.0
Ongana	*	*	58.6	41.4	8.5	4.4	49.1	54.4
Purunga	*	*	*	50.0	5.3	12.6	43.7	75.9
Kudekela	*	*	*	*	25.0	9.6	43.0	50.0
Potia	*	*	*	*	*	23.9	15.4	7.5
Dharamjaigarh	*	*	*	*	*	*	20.0	14.1
Chhal	*	*	*	*	*	*	*	45.5
Rupunga	*	*	*	*	*	*	*	*
Aamgaon	*	*	*	*	*	*	*	*

Table 3: Density of 10 top ranking food plants

S.No.	***Name of Species***	***Botanical Name***	***Family***	***Density***
1	Saja	*Terminallia tomentosa*	Combretaceae	76.3
2	Char	*Buchanania lanzan*	Anacardiaceae	61.23
3	Mahuwa	*Madhuca indica*	Sapotacceae	25.2
4	Kekar	*Garuga pinnata*	Burseraceae	15.8
5	Jamun	*Syzygium cumini*	Myrtaceae	9.04

6	Shisham	*Dalbergia latifolia*	Leguminosae	5.24
7	Harra	*Termenalia chebula*	Combretaceae	4.25
8	Khair	*Acacia catechue*	Leguminosae	2.55
9	Aam	*Mangifera sylvatica*	Anacardiaceae	0.37
10	Bargad	*Ficus bengalensis*	Moraceae	0.31

Table4:Annexure-I: Food plants of Asian elephant in Dharamjaigarh Forest Division, Chhattisgarh, India

S. No.	*Name of Species*	*Botanical Name*	*Family*	*Stem with leaves*	*Bark*	*Fruit*	*Density (per Ha.)*
1	Sal	*Shorea robusta*	Dipterocarpaceae	-	-	-	220.3
2	Saja	*Terminallia tomentosa*	Combretaceae	Y	-	Y	76.3
3	Char	*Buchanania lanzan*	Anacardiaceae	Y	Y	Y	61.23
4	Tendu	*Diospyros melanoxylon*	Ebenaceae	-	-	-	32.7
5	Dhawara	*Anogeissus ltifolia*	Combretaceae	-	Y	-	32.4
6	Mahuwa	*Madhuca Indica*	Sapotacceae	Y	-	Y	25.2
7	Senha	*Lagerstroemia parviflora*	Lythraceae	-	-	-	24.38
8	Kekar	*Garuga pinnata*	Burseraceae	Y	Y	Y	15.8
9	Jamun	*Syzygium cumini*	Myrtaceae	Y	Y	Y	9.04
10	Teak/Sagon	*Tectona grandis*	Verbenaceae	-	-	-	8.31
11	Shisham	*Dalbergia latifolia*	Leguminosae	Y	-	-	5.24
12	Harra	*Termenalia chebula*	Combretaceae	Y	-	Y	4.25
13	Khair	*Acacia catechue*	Leguminosae	Y	Y	-	2.55
14	Haldu	*Adina cordifilia*	Rubiaceae	-	-	-	2.14
15	Amaltas	*Cassia fitula*	Leguminosae	-	-	-	1.51
16	Kusum	*Schleichera oleosa*	Sapindaceae	-	-	-	0.82
17	Palas	*Butea monosperma*	Leguminosae	-	-	-	0.45
18	Aam	*Mangifera sylvatica*	Anacardiaceae	Y	Y	Y	0.37
19	Semal	*Salmalia malabarica*	Malvaceae	-	-	-	0.32
20	Bargad	*Ficus bengalensis*	Moraceae	Y	-	Y	0.31
21	Arjun	*Terminalia arjuna*	Combretaceae	-	-	-	0.23
22	Bel	*Aegle marmelos*	Rutaceae	-	-	-	0.23
23	Peppal	*Ficus religiosa*	Moraceae	Y	-	Y	0.12
24	Beer	*Zizyphus mauritiana*	Rhamnaceae	-	-	Y	0.11
25	Emli	*Tamarindus indica*	Leguminosae	-	-	Y	0.10
26	Kullu	*Sterculia urens*	Streculiaceae	-	-	Y	0.10
27	Chirol	*Holoptelea integriflolia*	Ulmaccae	-	-	Y	0.10
28	Anjan	*Hardwickia binata*	Leguminosae	-	-	-	0.10
29	Dhaman	*Grewia tiliaefolia*	Tiliaceae	-	-	-	0.10
30	Gamari	*Gmelina arborea*	Verbenaceae	-	-	-	0.10
31	Dimaru	*Ficus glomerata*	Moraceae	-	-	-	0.10
32	Kathjamun	*Eugenia heyneana*	Myetaceae	-	-	-	0.10
33	Amloki	*Emblica offinalis*	Euphorbiaceae	-	-	-	0.10
34	Galgala	*Cochlosperium religiosum*	Bixaceae	-	-	-	0.10
35	Bhara	*Chloroxylon swietenia*	Meliaceae	-	-	-	0.10
36	Kuhir	*Bridelea retusa*	Euphorbiaceae	-	-	-	0.10
37	Kachnar	*Bauhinia variegate*	Leguminosae	-	-	-	0.10

38	Kanchan	*Bauhinia purpurea*	Caesalpiniaceae	-	-	-	0.10
39	Amta	*Bauhinia malabarica*	Leguminosae	-	-	-	0.10
40	Kadam	*Anthocephalus chinensis*	Rubiaecea	-	-	-	0.10
41	Kalasirish	*Albizzia lebbek*	Leguminosae	-	-	-	0.10
42	Karoi	*Albiziz procera*	Mimosaceae	-	-	-	0.10
43	Akol	*Alangium salvifolium*	Conaceae	-	-	-	0.10
44	Amrud	Psidium guajava	Myrtaceaer	-	-	Y	0.10
45	Kassi	Bridelia retusa	Phyllanthaceae	-	-	-	0.10
46	Bheri	Ziziphus nummularia	Rhamnaceae	-	-	-	0.10
47	Pakri	Ficus virens	Moraceae	-	-	-	0.10

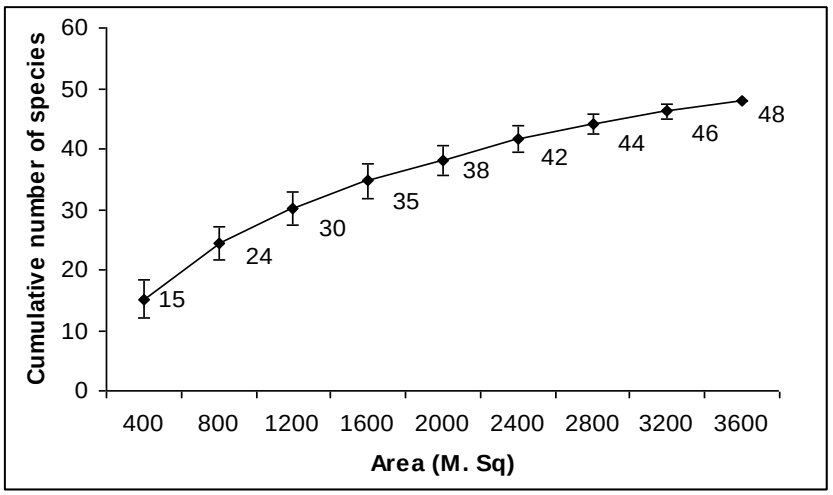

Figure 1: Species area curve for the study region

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RESEARCH ARTICLE

Solar Powered Cost-Effective Node MCU - IOT Based Smart Cradle / Incubator

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ABSTRACT

The interest of developed progressed control for hatchery is violently expanding because of the meaning of decreasing the demise proportion among the newborn child. In hatchery, there are quantities of boundaries should be observed. This paper introduced a development control framework used to screen some significant boundaries that influence the existence of newborn child. This procedure at the same time observed and controlled more than one boundary with cutting edge control and gives smooth activity assists with expanding the precision of the framework. The proposed framework contains two temperature sensors which are utilized to change the hatchery temperature and stretched out to screen the skin temperature and sunlight powered charger is utilized. The framework utilized a dampness sensor to distinguish regardless of whether child is peed. Here we are utilizing beat sensor to gauge BPM (Beats Per Minute). To keep up with the hatchery temperature in ideal level the cooling fan and it are utilized to warm bulb. These two are consequently constrained by Arduino miniature regulator in view of hatchery temperature esteem. In this framework two press buttons are utilized to check taking care of fruition and full body examination fulfillment. An application page was intended to guarantee simple checking administration for client. The frameworks in view of Arduino and offer the capacity to control hatchery utilizing the IOT module.

Keywords: hatchery, temperature, sunlight powered charger, IOT, BPM.

INTRODUCTION

Over the earlier ten years medical care checking has not been extensively used. Medical care is a term of developing significance across the globe. In India, the term is known to just metropolitan populace while in provincial or semi metropolitan networks it is generally obscure. Country regions are not effectively open and the advances that exist in tertiary place and corporate medical clinics are not accessible them. In 2008, the quantity of associated gadgets is less while contrasted and the populace on the earth. By 2020, we anticipate 50 billion Connected Things. The idea of the Internet of Things involves the utilization of electronic gadgets that catch or screen information and are associated with private or public cloud, empowering them to set off specific occasions naturally. Web associated gadgets are being presented in different structures. Whether information comes from deadly screens, electrocardiograms, temperature screens or blood glucose levels, following wellbeing data is crucial for certain patients. Follow-up association with a medical care proficient is expected for the vast majority of these actions. This makes an opening for more intelligent gadgets to convey more important information, reducing the requirement for direct tolerant doctor collaboration. In India, the medical care industry is developing and very much past due for an overhaul. The development in this field is being driven by way of life sicknesses, a maturing populace, rising admittance to protection and developing wellbeing mindfulness. To guarantee the presence of a sound populace, reconnaissance check is need. Medical care reconnaissance is certainly not another term-it is the consistent checking and assortment of information of patients from wellbeing camps, clinics and so forth. In the approaching universe of Internet of Things (IOT), for medical services, unique and upset gadgets will assemble, break down and convey ongoing clinical data to open, private or half and half mists, making it conceivable to gather, store and examine enormous information streams in a few new structures and actuate setting dependant alerts. By centring the above issues, we need to create and plan a minimal expense shrewd newborn child hatchery for new conceived children to screen their ailment utilizing an IOT climate. In our proposed framework wellbeing observing boundaries are estimated by a sensor then the microcontroller handled the sensor values and afterward their handled qualities are put away in the internet-based server by means of IOT module. Besides, with the assistance of IOT climate, the information can be gotten to at anyplace whenever.

Existing System

The hatcheries are they screen and control the wellbeing boundaries of another conceived youngster. The circulatory strain screen is a machine that is associated with a little sleeve which folded over the arm or leg of the youngster. As numerous untimely infants have lost their lives because of absence of legitimate checking of the hatchery that prompts mishaps like spillage of gas and overheating causing short circuits and in the long run, the blasting of hatcheries.

Disadvantages

- There is an opportunity of high youngster passing proportion.
- Very Complexity Hospitalization framework.
- Treatment might take long time from specialist.

Proposed System

The framework comprises of Node MCU which is associated with the hatchery. The different sensors used to detect the boundaries related with the observing and control of a hatchery are coordinated with the Node MCU and sunlight-based charger. The Node MCU is customized to acquire the readings of these sensors and show it in this way empowering in the observing of the readings. The upsides of these sensors are refreshed IOT stage. The temperature and dampness sensor detects the temperature of the environmental elements and the mugginess present in the general climate of the youngster. Comparative the Node MCU is likewise customized to get the relationship readings from the beat sensor to screen the heartbeat of the newborn child. In the event that the temperature and dampness values surpass the predetermined reach (36.5-37.2°C) or when the presence beat rate is diminished. Then it is identified by the separate sensors observed by a regulator, a message or an email is shipped off the child's PCP and medical caretaker or others with the assistance of the IoT stage.

Advantages of Proposed System

- The qualities can be checked for each second. It will give exact qualities and that will be adjusted for each second.
- The specialists can check the child's wellbeing effectively and they can stay away from children having medical issues.

Block diagram

Software description

Arduino IDE

The Uno can be changed with the Arduino Software (IDE). Select "Arduino/Genuine Uno" from the Tools > Board menu (as indicated by the microcontroller on your board). For subtleties, see the refere The Uno can be changed with the Arduino Software (IDE). Select "Arduino/Genuine Uno" from the Tools > Board menu (as indicated by the microcontroller on your board). For subtleties, see the reference and educational exercises. The ATmega328 on the Uno comes set up with a boot loader that licenses you to move new code to it without the utilization of an outer stuff software engineer. It conveys utilizing the crucial STK500 show (reference, C header reports).You can moreover stay away from the boot loader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header utilizing Arduino ISP or close; see these principles for subtleties. On Rev1 sheets: frill the weld jumper on the rear of the board (close to the accomplice of Italy) and in this manner reseing the 8U2.On Rev2 or later sheets: there is a resistor that pulling the 8U2/16U2 HWB line to ground, making it much more obvious to place into DFU modern and illuminating exercises. The ATmega328 on the Uno comes set up with a boot loader that awards you to move new code to it without the utilization of an outside gear developer. It conveys utilizing the boss STK500 show (reference, C header reports).You can other than avoid the boot loader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header utilizing Arduino ISP or close; see these guidelines for subtleties. The ATmega16U2 (or 8U2 in the rev1 and rev2 sheets) firmware source code is open in the Arduino vault. The ATmega16U2/8U2 is stacked with a DFU boot loader, which can be impacted by:

- On Rev1 sheets: extra the weld jumper on the rear of the board (close to the accomplice of Italy) and starting there on reseing the 8U2.
- On Rev2 or later sheets: there is a resistor that pulling the 8U2/16U2 HWB line to ground, making it much more obvious to place into DFU mode.

CONCLUSION

Internet of things (IoT) is getting part of extension in large businesses and associations. Yet, this isn't true with rustic regions, immature urban communities and towns. Numerous utilizations of IoT like this work will acquire uncommon changes in rustic regions and furthermore in clinical industry by giving a less expensive and more successful savvy hatchery. We have planned this utilizing open-source assets like Arduino, subsequently every time there is an improvement or update in this open-source innovation, we can make this component more proficient and competent. Each part is intended to squeeze into just a single area with the goal that it is instinctive for any wellbeing specialist to gather. What's more, this will permit target wellbeing focus to increase hatchery highlights without purchasing another model. Hatchery will be planned with locally accessible materials that have parts that are effectively replaceable. Furthermore, finally there will be constant observing where the temperature of at least one hatcheries can be effortlessly controlled utilizing the application as opposed to dealing with physically. In future more country regions can execute this instrument for giving safe brooding to preterm babies and acquire an associated climate in clinics without effective financial planning on additional exorbitant brilliant hatcheries.

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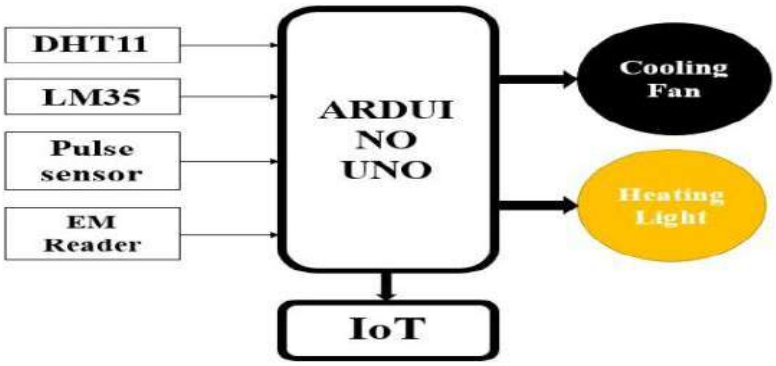

Fig: 1 block diagram

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RESEARCH ARTICLE

Effect of Mepiquat Chloride on Growth, Yield and Quality of Jathi Malli (*Jasminum grandiflorum* L.)

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ABSTRACT

A study was conducted during the year 20018-2019 to find out the "Effect of mepiquat chloride on growth, yield and quality of jathi malli (*Jasminum grandiflorum* L.)" in randomized block design with eight treatments and three replications. The treatments included T_1 (Mepiquat chloride 25 ppm foliar spray at 45th and 90th days after pruning [DAP]), T_2 (Mepiquat chloride 50 ppm foliar spray at 45th and 90th DAP), T_3 (Mepiquat chloride 75 ppm foliar spray at 45th and 90th DAP), T_4 (Mepiquat chloride 100 ppm foliar spray at 45th and 90th DAP), T_5 (Mepiquat chloride 125 ppm foliar spray at 45th and 90th DAP), T_6 (Mepiquat chloride 150 ppm foliar spray at 45th and 90th DAP), T_7 (Mepiquat chloride 175 ppm foliar spray at 45th and 90th DAP) and T_8 (Control-water spray at 45th and 90th DAP). The various treatments significantly influenced the growth, yield and quality attributes of jasmine – jathi malli. The results indicated that the increasing concentration of mepiquat chloride reduced the plant height and internodal length, but the appropriate height and internodal length was observed in treatment T_3. The other growth characters like number of branches per plant, number of leaves per branch, chlorophyll content and early flower bud appearance were recorded the best in the treatment T_3 which received the application of mepiquat chloride 75 ppm foliar spray. The plant spread and leaf area were recorded the maximum in T_8 (control), which was closely followed by treatment T_3. The yield and yield attributes *viz.*, hundred flower buds weight and flower buds yield per plant per year were also found to be the maximum in the plants treated with mepiquat chloride 75 ppm foliar spray on 45th and 90th DAP (T_3). In this study, the application of mepiquat chloride 75 ppm foliar spray on 45th and 90th DAP exerted favourable influence

and enhanced the flower quality characters like flower bud length, corolla tube length, shelf life and visual scoring.

Keywords: Early flower bud appearance, flower bud length, hundred flower buds weight, internodal length, jathi malli, mepiquat chloride.

INTRODUCTION

India has a long tradition of floriculture, with flowers forming an integral part of almost all the religious, social and cultural activities of Indian society. Commercial floriculture in India comprises of both the modern and the traditional groups of flowers. Among the traditional flowers, jasmines are the most significant flowers. Jasmine flowers are used for various purposes *viz.,* making garlands, bouquets, adoring hair of women, religious offering and concrete extraction. Jathi malli (*Jasminum grandiflorum* L.) is an ornamental plant of Oleaceae family. The pretty jasmine flower originated in the lower valleys of the Himalayas of northern India [1]. Presently India is the second largest producer of flowers after China. In India, area under floriculture production was 308 thousand ha with a production of 1806 thousand tonnes of loose flowers and 704 thousand tonnes of cut flowers. India has exported 20703.46 metric tonnes of floriculture products to the world for the worth of Rs. 507.31 crores in 2018-19. United States of America, United Kingdom, Germany, Netherlands and United Arab Emirates were the major importing countries of Indian floriculture products during 2018-19 (APEDA AgriXchange, 2018). Tamil Nadu stands first in the area under flower cultivation (35.30 thousand ha) as well as loose flower production (520.38 thousand metric tonnes) in 2018-19 (http://tnhorticulture.tn.gov.in.gov.in/horti/flowers). In India, jasmines are cultivated throughout the country. However, the largest area under jasmine flower production is in Tamil Nadu followed by Karnataka [2].

One of the serious limiting factor affects both jasmine flower growers and the consumers is that the flowering of all the *Jasminum* species is seasonal. The time of peak flowering does not coincide with the time of high demand. Further, any cultural practices which will induce more flowering during the heavy demand period even in the regular season will also be much more useful to both the farmers and consumers. There are several methods that growers utilize to manipulate growth and development of the plant to achieve higher production. Among this, using of growth retardants is an appropriate practice followed in floriculture for manipulating growth and flowering of many flower crops. Plant growth retardants are used for controlling many aspects of plant growth and development, including plant height modification, flower initiation, and flower yield. Several retardants interrupt physiological pathways of hormones and enzymes, which disrupt normal growth. Many of these modes of action are far less obvious and understood than are the results that they produce [3]. In the recent years, a number of plant growth retardants have been used in the field of agriculture for inducing more acceptable plant characteristics like compact growth, dwarfness and increased number of healthy branches which are the desired traits in modern floriculture industry [3-5]. It´s also used to regulate shoot growth, stem elongation, to induce secondary branches, early flowering, to increase the number of flowers, reductions of leaf expansion and to get thicker leaves with deep green colour. It also increases the tolerance to plants to temperature and drought stress, thereby improving shelf life and extending the flower marketability [2]. Mepiquat chloride is heavily used in cotton production. It was introduced in market in late 1970´s as a PGR to suppress excessive plant growth by decreasing plant height, internodal length, branch length and leaf area [6]. It acts by inhibiting gibberellin biosynthesis like other growth retardants. The application of mepiquat chloride in *J. sambac* were significantly influenced the growth and yield parameters along with the biochemical parameters *viz*., chlorophyll index, total phenol content and soluble protein [7]. The available information regarding the impact of growth retardant mepiquat chloride on the jasmines especially in *Jasminum grandiflorum* L. is scanty. Keeping in view of the above facts, the present study entitled "Effect of mepiquat chloride on growth, yield and quality of jasmine - Jathi malli (*Jasminum grandiflorum* L.)" was undertaken.

MATERIALS AND METHODS

The present study was carried out in Kuppanatham village at Vriddhachalam taluk of Cuddalore district during the year 2018-19 in randomized block design with eight treatments and three replications. The treatments included T_1 (Mepiquat chloride 25 ppm foliar spray at 45th and 90th days after pruning [DAP]), T_2 (Mepiquat chloride 50 ppm foliar spray at 45th and 90th DAP), T_3 (Mepiquat chloride 75 ppm foliar spray at 45th and 90th DAP), T_4 (Mepiquat chloride 100 ppm foliar spray at 45th and 90th DAP), T_5 (Mepiquat chloride 125 ppm foliar spray at 45th and 90th DAP), T_6 (Mepiquat chloride 150 ppm foliar spray at 45th and 90th DAP), T_7 (Mepiquat chloride 175 ppm foliar spray at 45th and 90th DAP) and T_8 (Control-water spray at 45th and 90th DAP). The Plants taken up for the trials were already existing one, which were pruned during the last week of December 2017 uniformly and the treatments were imposed during the last week of January 2018. The recommended dose of nutrients such NPK @ 30:60:60 g / plant / year was applied in the form of Urea (46.4% N) Single Super Phosphate (16.5% P_2O_5) and Muriatic of Potash (60% K_2O) respectively. Half dose of nitrogen and full dose of P_2O_5 and K_2O mixed with 5 kg FYM were applied to all the treatments immediately after pruning. Irrigation was done as flooding for the individual replication once in a week or once in ten days depending upon the soil and climatic conditions. Weeds were removed periodically by hand weeding. Other cultivation practices including plant protection measures were carried out as the recommended package of practices. Mepiquat chloride is water soluble in nature and hence the formulation was dissolved in distilled water and then volume was made up to the solution needed with desired concentration. Spray was done on 45th and 90th day after pruning, when the new shoots appeared with sufficient good number of freshly emerged shoots with leaves. The freshly prepared chemical formulation was sprayed at different concentrations. The biometric observations like growth and physiological parameters, plant height (cm), number of branches per plant, number of leaves per branch, internodal length (cm), plant spread (cm^2), leaf area (cm^2), chlorophyll content (mg g^{-1}), yield and quality parameters such as days taken for first flower bud appearance, flower bud length (cm), corolla tube length (cm), hundred flowers weight (g), flower bud yield (g $plant^{-1}year^{-1}$), visual scoring and shelf life (hours) were taken during this study. The chlorophyll content was measured as per the procedure [8]. The data on various parameters were analysed statistically [9].

RESULTS AND DISCUSSION

The various treatments significantly influenced the plant growth, physiological, yield and quality characters. The data on growth & physiological parameters (Table 1) showed that the application of mepiquat chloride at 25, 50, 75, 100, 125, 150 and 175 ppm were very effective in suppressing the plant height and the degree of retardation increased with the respective higher concentration. The minimum plant height was recorded in T_7 (Mepiquat chloride 175 ppm foliar spray at 45th and 90th DAP) with value of 107.13 cm on 180 DAP and it is followed by T_6 (Mepiquat chloride 150 ppm foliar spray at 45th and 90th DAP). The reduction of plant height is related to the balance of the hormones caused by the application of growth retardants, which interferes with the biosynthesis of gibberellic acid and inhibits the formation of this hormone in plant which ultimately reduced the plant height through physiological changes [10]. The minimum internodal length was exhibited in the treatment T_7. The results were also stated by [11] in lily 'Enchantment' and [7] in *Jasminum sambac.*

The number of branches per plant were found to be the high in the treatment T_3 with value of 71.95 at 180 DAP which received the application of mepiquat chloride 75 ppm foliar spray at 45th and 90th DAP. This is followed by treatment T_4 which received the application of 100 ppm mepiquat chloride foliar spray at 45th and 90th DAP. This might be due to the effect of application on growth retardants which inhibited gibberellins biosynthesis. With the reduced concentration of gibberellins due to growth retardants application, there is a less elongation of cells in the stem which restrict the vertical growth and increased the branches both the side due to the suppression of apical dominance. This favours the production of secondary branches of plant in appropriate concentration of growth retardants. This findings are in accordance with the findings of [12, 7] in *Jasminum sambac* and [13] in sunflower. Production of leaves was enhanced by the application of mepiquat chloride which may be due to the production of

more number of branches by treating the plants with mepiquat chloride 75 ppm concentration. In *J. grandiflorum* L., application of mepiquat chloride 75 ppm foliar spray at 45th and 90th DAP produced the maximum number of leaves. These have supportive evidence from the findings of [11] in lily 'Enchantment' and [14] in lemon grass.

The number of leaves and plant spread are the main photosynthetic characters in plants and synthesize the various metabolites required for plant growth and development. These characters play an impressive role in photosynthetic efficiency of the plant. The results of the present study have indicated the maximum plant spread in T_{10} (Control), followed by treatment T_3. This might be due to the fact that mepiquat chloride at optimum concentration is capable of inducing more branches of current season which is a foremost requirement of jasmine because of it flowering on current season growth in a compact plant ideotype. Similar results were reported by [15] in floricultural crops and [16] in chrysanthemum. In the present study, the leaf area got reduced by application of growth retardants but, the maximum leaf area of 12.74 cm^2 was observed in (T_8) control, which was closely followed by T_3 and T_4. The leaves of plants treated with retardants are deep green in color due to enhanced synthesis of chlorophyll and produced thicker leaf blades with reduced leaf area [17]. These results were in conformity with the findings of [18] in brush cherries (*Syzygium campanulatum.* Among the various treatments, the treatment T_3 recorded the maximum value of chlorophyll content (1.601 mg g^{-1}), followed by treatment T_4 with the value of 1.577 mg g^{-1}. The plant spread, number of leaves, leaf area and chlorophyll content are more directly related to the photosynthetic efficiency of the plant [19, 20] in gladiolus and [21] in chrysanthemum.

The data on days to commencement of flowering revealed that early flowering was observed with the application of mepiquat chloride 75 ppm foliar spray at 45th and 90th DAP with the value of 66.65 days, followed by treatment T_4 with 67.81 days. This might have been due to the fact that growth retardants would cause artificial stress in the plant system which would trigger the reproductive mechanism in the plant system earlier by using the sufficient food reserves generated by the jasmine plant due to appropriate level of growth retardant spray such as mepiquat chloride [7]. Similar results were found by [22-23] in cotton. The flower quality characters of jasmine like maximum flower bud length (4.22 cm) and corolla tube length (2.17 cm) were observed in the treatment T_3, followed by T_4 and T_5. This is because mepiquat chloride can restrict vegetative growth, inducing the plant to direct more carbohydrates and nutrients to the reproductive organs to play their role on flowering. These results are in conformity with the findings of [24] in calendula, [25] in annual chrysanthemum and [7] in jasmine. The highest value of hundred flower buds weight (9.41 g) and flower buds yield plant^{-1} year^{-1} (3.05 kg) of yield characters were observed in the treatment T_3. It may be related to diversion of photosynthates towards the axillary buds and inhibition of apical dominance, which would have triggered the reproductive shoots as more number of current season branches in which jasmines would produce flowers. This goes in line with earlier reports by [26, 27 & 7] in jasmine. The more number of branches ultimately resulted in increased yield of flower buds. Thus, it appears that flower yield depends on number of branches on the current season. Due to the production of more number of leaves in mepiquat chloride treated plants, resulted in increased photosynthesis and ultimately a large reserve food source leading to production of more number of flowers per plant. This findings were supported by [26, 27 & 7] in jasmine. The application of mepiquat chloride 75 ppm resulted in early flowering because at optimum concentration it redirects the carbohydrates away from vegetative to reproductive growth earlier for a lengthy flowering period which ultimately resulted in increased yield [22-23] in cotton, [28] and [29] in sunflower. With regards to other quality aspect like shelf life (33.12 hours) and visual scoring (9.56), the treatment T_3 was found to be excellent treatment followed by treatment T_4 and T_5. Better quality of jasmine flowers might be due to higher carbohydrate, other essential nutrients, plant growth regulators and enzymes deposition in flower cells. This finding was in agreement with the observation made by [7] in *Jasminum sambac*.

CONCLUSION

From the above results, it is concluded that application of mepiquat chloride 75 ppm foliar spray at 45th and 90th DAP (T_3) was found to be beneficial and economically feasible for the effective cultivation of jasmine – jathi malli

(*Jasminum grandiflorum* L.) for more yield, early flower bud appearance and good quality flowers under open field condition followed by T_4 (Mepiquat chloride 100 ppm foliar spray at 45th and 90th DAP).

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Table: 1 Effect of mepiquat chloride on growth and physiological parameters of Jathi malli (*Jasminum grandiflorum* L.)

Treatments	Plant height (cm)	No. of branches per plant	No. of leaves per branch	Internodal length (cm)	Plant spread (cm^2)	Leaf area (cm^2)	Chlorophyll content (mg g^{-1})
T_1	151.68	68.82	114.28	7.87	108.59	12.09	1.521
T_2	143.99	69.39	115.54	7.57	109.98	11.87	1.542
T_3	137.79	71.95	119.79	7.21	114.34	12.55	1.601
T_4	130.47	70.36	117.64	6.85	112.78	12.32	1.577
T_5	127.44	69.81	116.52	6.56	111.52	11.65	1.557
T_6	117.11	68.15	113.29	6.23	107.13	11.43	1.502
T_7	107.13	67.33	112.91	5.87	105.61	11.26	1.481
T_8	159.67	66.76	111.96	8.26	115.73	12.74	1.461
S.Ed	**3.65**	**0.36**	**0.54**	**0.16**	**0.71**	**0.09**	**0.008**
CD (P=0.05)	**7.31**	**0.72**	**1.09**	**0.32**	**1.42**	**0.19**	**0.017**

Table: 2 Effect of mepiquat chloride on yield and quality parameters of Jathi malli (*Jasminum grandiflorum* L.)

Treatments	Days taken for first flower bud appearance	Flower bud length (cm)	Corolla tube length (cm)	Hundred flower buds weight (g)	Flower bud yield(g $plant^{-1}$ $year^{-1}$)	Visual scoring	Shelf life (hours)
T_1	71.66	3.74	1.99	8.47	2.66	8.68	27.36
T_2	70.34	3.87	2.04	8.72	2.76	8.91	28.79
T_3	66.65	4.22	2.17	9.41	3.05	9.56	33.12
T_4	67.81	4.08	2.11	9.14	2.95	9.31	31.59
T_5	69.15	3.96	2.06	8.91	2.83	9.08	30.18
T_6	72.99	3.62	1.93	8.23	2.55	8.42	25.91
T_7	73.36	3.48	1.87	7.98	2.46	8.21	24.49
T_8	75.72	3.35	1.82	7.71	2.34	7.94	23.04
S.Ed	**0.63**	**0.06**	**0.02**	**0.11**	**0.04**	**0.10**	**0.69**
CD (P=0.05)	**1.26**	**0.12**	**0.04**	**0.22**	**0.08**	**0.20**	**1.39**

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RESEARCH ARTICLE

m-Regular Neutrosophic Fuzzy Matrices

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ABSTRACT

The objective of this paper is to learn about the idea of m - Regular Neutrosophic Fuzzy Matrix (NSFM) as a speculation of Regular Fuzzy Matrix and a few fundamental properties of a m - regular NSFM are determined. Further, that is the thing we exhibit in case any NSFMs are m-regular, its membership(T), non-membership (F) and indeterminancy(I) fuzzy matrices are in like manner are m-regular.

Keywords: Fuzzy Matrix, Neutrosophic Fuzzy Matrix, m-Regularity, m-ordering.

INTRODUCTION

Scholastics in financial aspects, social science, clinical science, modern, climate science and numerous other various fields concur with the dubious, loose and rarely inadequate with regards to data of showing estimated information. Subsequently, fuzzy set hypothesis was presented by L. A. Zadeh [10]. Then, at that point, the intuitionistic fuzzy sets was created by K. A. Atanassov [1, 2]. Assessment of non-membership values is additionally not continually feasible for the indistinguishable explanation as in the event of participation esteems thus, there exists an indeterministic part whereupon delay endures. Therefore, Smarandache et al. [4, 8, 9] has presented the idea of Neutrosophic Set (NS) which is a speculation of customary sets, fuzzy set, intuitionistic fuzzy set and so on. The issues concerning different kinds of dithering's can't addressed by the old style framework hypothesis. That kind of issues are settled by utilizing fuzzy matrix [5, 6]. Fuzzy framework manages just participation values. These frameworks can't bargain non participation values. Intuitionistic fuzzy matrices (IFMs) presented first time by Khan, Shyamal and Pal [6]. Kim and Roush have fostered a hypothesis for fuzzy matrices closely resembling that for Boolean Matrices by broadening the max.min procedure on fuzzy polynomial math F =[0,1], for components a,bεF, a+b = max{a,b} and a.b = min{a,b}[3].In [5], Meenakshi have determined different sorts of requesting on ordinary

fuzzy matrices. Fuzzy matrices concurred with just participation values. In [7], Poongodi et.al have given the new portrayal on Neutrosophic fuzzy matrices. In this paper, the idea of m - Regular Neutrosophic Fuzzy Matrix (NSFM) as a speculation of Regular Fuzzy Matrix and a few fundamental properties of a m - regular NSFM are determined. Further, that is the thing we exhibit in case any NSFMs are m-regular, its membership(T), non-membership (F) and indeterminancy(I) fuzzy matrices are in like manner are m-regular.

Preliminaries:

In this part, a few fundamental definitions and results required are given. Let N_n signifies the arrangement of all nxn Neutrosophic Fuzzy Matrices.

Definition

A matrix C $\in F_n$ is known as to be regular that there exist a matrix U $\in F_n$, to such an extent that CUC =C. Then, at that point, U is called g-reverse of C. Let C{1} = {U/CUC = C}. F_n signifies the arrangement of all fuzzy matrices of order nxn.

Definition

A matrix C$\in F_n$ is known as right m – regular, assuming there exist a matrix U$\in F_n$, to such an extent that $C^mUC = C^m$, for some sure whole number m. U is named as right m-g inverse of C. Let $C_r\{1^m\} = \{U/ C^mUC = C^m\}$.

Definition

A matrix C$\in F_n$ is known as left m – regular, assuming there exist a matrix V$\in F_n$, to such an extent that $CVC^m = C^m$, for some sure whole number m. V is named as left m-g inverse of C. Let C={V/$CVC^m=C^m$ }.

Definition

An neutrosophic fuzzy matrix (NSFM) C of order m × n is defined as C= $[X_{ab},<c_{(ab)T}, c_{(ab)F}, c_{(ab)I}>]_{mUn}$, where $c_{(ab)T}, c_{(ab)F}$ $c_{(ab)I}$ are called enrollment work (T), the non-participation (F) work and the indeterminancy work (I) of U_{ab} in C, which sustaining the condition $0 \le (c_{(ab)T,}+ c_{(ab)F,} + c_{(ab)I}) \le 3$. For simplicity, we write C = $[c_{ab}]_{mxn}$ where $c_{ab} = <c_{(ab)T}, c_{(ab)F}, c_{(ab)I}>$. Let N_n symbolizes the arrangement of all nxn NSFM. Let C and D be any two NSFMs. The accompanying activities are characterized for any two-component $c_{ab}\in$ C and $d_{ab}\in$ D, where c_{ab} $=[c_{(ab)T}, c_{(ab)F}, c_{(ab)I}]andd_{ab}$ $=[d_{(ab)T}, d_{(ab)F}, d_{(ab)I}]$arein[0,1] with the end goal that $0 \le (c_{(ab)T} + c_{(ab)F,} + c_{(ab)I}) \le 3$ and $0 \le (d_{(ab)T,}+ d_{(ab)F,} + d_{(ab)I}) \ge 3$, thenab

$c_{ab} + d_{ab}$=[max $\{c_{(ab)T,}, d_{(ab)T}\}$, max$\{c_{(ab)F}, d_{(ab)F}\}$, min$\{c_{(ab)I}, d_{(ab)I}\}$]

$c_{ab} . d_{ab}$=[min $\{c_{(ab)T,}, d_{(ab)T}\}$, min$\{c_{(ab)F}, d_{(ab)F}\}$, max$\{c_{(ab)I}, d_{(ab)I}\}$]

Here weshall track the elementaryo perationson NSFM.

For$C=(c_{ab})=[c_{(ab)T}, c_{(ab)F}, c_{(ab)I}]andD=(d_{ab})=[d_{(ab)T}, d_{(ab)F}, d_{(ab)I}]$ of order mxn, their total indicated as C + D is characterized as,

$C+ D=(c_{ab} +d_{ab})=[(c_{(ab)T,}+d_{(ab)T}), (c_{(ab)F} + d_{(ab)F}), (c_{(ab)I} + d_{(ab)I})]$ ….(2.1)

For $C= (c_{ab})_{mxn}$ and $D=(d_{ab})_{nxp}$ their product indicated as CD is characterized as,

$CD= (e_{ab}) = \sum_{k=1}^{n} c_{bk} . d_{kb}$

$= \sum_{k=1}^{n}(c_{(ak)T,}. d_{(kb)T}), \sum_{k=1}^{n}(c_{(ak)F} . d_{(kb)F}), \sum_{k=1}^{n} c_{(ak)I} . d_{(kb)I}$ ...(2.2)

Lemma

For C, D $\in N_{mn}$

1. If the row space of D contained in the row space of C then which is equivalent to D = UC for some U $\in N_m$ i.e. R(D) ⊆ R(C) ⇔ D=UC for some U$\in N_m$
2. If the column space of D contained in the column space of C then which is equivalent to D = CV for some V$\in N_n$. i.e. C(D) ⊆ C(D) ⇔ D = CV for some V$\in N_n$

Lemma

For $C \in N_{mn}$ and $D \in N_{nm}$, the following hold.

(i) The row space of CD, which is contained in the row space of C, i.e. $R(CD) \subseteq R(C)$

(ii) The column space of CD, which is contained in the column space of D , i.e. $C(CD) \subseteq C(D)$

Lemma

For $C=[C_T, C_F, C_I] \in N_{mn}$and $D=[D_T, D_F, D_I] \in N_{nm}$, the following hold.

(i) $C^T = [C_T{}^T, C_F{}^T, C_I{}^T]$

(ii) $CD = [C_TD_T, C_FD_F, C_ID_I]$

Generalizedor m-regular neutrosophic fuzzy matrices.

Here, we concentrate on the idea of m - regular NSFM. A few fundamental properties utilizing m - g inverses of NSFM are inferred. The row and column rank of a m - regular NSFM are determined as a generalization of the results found in fuzzy matrices.

Right m -Regular Neutrosophic Fuzzy Matrices

A matrix $C \in N_n$ is known as right m – regular, assuming there exist a matrix $U \in N_n$, to such an extent that $C^mUC = C^m$, for some sure whole number m. U is named as right m-g inverse of C. Let $C_r\{1^m\} = \{U/ C^mUC = C^m\}$.

Left m -Regular Neutrosophic Fuzzy Matrices

A matrix $C \in N_n$ is known as left m – regular, assuming there exist a matrix $V \in N_n$, to such an extent that $CVC^m = C^m$, for some sure whole number m. V is named as left m-g inverse of C. Let $C=\{V/CVC^m=C^m\}$. In general, right m – regular NSFM is different from left m – regular NSFM. Hence a right m – g inverse need not be a left m – g inverse.

Example

Let us consider C = $\begin{pmatrix} [0, 0,1] & [0.2,0.5, 0] & [0, 0, 0] \\ [0, 0, 1] & [0.5, 1, 0] & [0.3,0.5, 0] \\ [0.1,0.5, 1] & [0, 0, 0] & [0, 0, 0] \end{pmatrix} \in N_{3x3}$.

For this C, C^2= $\begin{pmatrix} [0, 0, 1] & [0.2,0.5, 0] & [0.2, 0.5, 0] \\ [0.1, 0.5, 1] & [0.5, 1, 0] & [0.3, 0.5, 0] \\ [0, 0, 1] & [0.1, 0.5, 0] & [0, 0, 0] \end{pmatrix}$

C^3 = $\begin{pmatrix} [0.1, 0.5, 1] & [0.2,0.5, 0] & [0.2, 0.5,0] \\ [0.1, 0.5, 1] & [0.5, 1, 0] & [0.3, 0.5, 0] \\ [0, 0, 1] & [0.1, 0.5, 0] & [0.1, 0.5, 0] \end{pmatrix}$

For X = $\begin{pmatrix} [0.4, 0.5, 1] & [0, 0, 0] & [0.3, 0.5, 0] \\ [0.2, 0.5, 1] & [0.5, 1, 0] & [0, 0, 0] \\ [0, 0, 1] & [0.4, 0.5, 0] & [0, 0, 0] \end{pmatrix}$

$C^3XC=C^3$. Hence C is 3 – regular NSFM. For m=3, $C^3XC=C^3$ but $CXC^3 \neq C^3$. Hence X is a right 3 – g inverse but not a left 3 – g inverse of a NSFM C.

Remark

In particular for m =1, Definitions (3.1) and (3.2) reduce to regular NSFM, and in the case $C_T = C_F = C_I$, Definitions (3.1) and (3.2) reduce to right m – regular fuzzy matrix and left m – regular fuzzy matrix.

Theorem

Let $C=[C_T, C_F, C_I] \in N_n$. Then C is right m-regular Neutrosophic Fuzzy Matrix $\Leftrightarrow$ C_T, C_F and C_I are also right m – regular Neutrosophic Fuzzy Matrix.

Proof:

Let $C=[C_T, C_F, C_I] \in N_n$.

Since C is a right m-regular Neutrosophic Fuzzy Matrix, there exists $x \in N_n$, such that

$C^m X C = C^m$.

Let $X=[X_T, X_F, X_I]$ with $X_T, X_F, X_I \in N_n$.

Then by lemma (2.7)(ii)

$C^m X C = C^m$

$\Rightarrow [C_T, C_F, C_I]^m [X_T, X_F, X_I][C_T, C_F, C_I] = [C_T, C_F, C_I]^m$

$\Rightarrow [C_T^m, C_F^m, C_I^m][X_T, X_F, X_I][C_T, C_F, C_I] = [C_T^m, C_F^m, C_I^m]$

$\Rightarrow [C_T^m X_T C_T, C_F^m X_F C_F, C_I^m X_I C_I] = [C_T^m, C_F^m, C_I^m]$

$\Rightarrow C_T^m X_T C_T, = C_T^m, C_F^m X_F C_F = C_F^m, C_I^m X_I C_I = C_I^m$

$\Rightarrow C_T, C_F$ and C_I are also right m – regular Neutrosophic Fuzzy Matrix.

Thus C is right m-regular Neutrosophic Fuzzy Matrix $\Rightarrow$ C_T, C_F and C_I are also right m – regular Neutrosophic Fuzzy Matrix. Conversely, Suppose $C_T, C_F, C_I \in N_n$ are right m – regular, then

$C_T^m X_T C_T, = C_T^m, C_F^m X_F C_F = C_F^m$ and $C_I^m X_I C_I = C_I^m$

For some X_T, X_F and $X_I \in N_n$.

Let $Z=[U, V, W] \in N_n$

Then by lemma (2.7)(ii)

$C^m Z C = [C_T, C_F, C_I]^m [U, V, W][C_T, C_F, C_I]$

$= [C_T^m, C_F^m, C_I^m][U, V, W][C_T, C_F, C_I]$

$= [C_T^m U C_T, C_F^m V C_F, C_I^m W C_I]$

$= [C_T^m, C_F^m, C_I^m]$

$= C^m$.

Thus C is right m-regular Neutrosophic Fuzzy Matrix. Hence the theorem.

Theorem

Let $C=[C_T, C_F, C_I] \in N_n$. Then C is a left m-regular Neutrosophic Fuzzy Matrix $\Leftrightarrow$ C_T, C_F and C_I are also left m - regular Neutrosophic Fuzzy Matrix.

Proof:

The proof is similar to the proof of Theorem 3.5.

Lemma

For $C=[C_T, C_F, C_I], D=[D_T, D_F, D_I] \in N_n$ and a positive integer m, the following hold.

i)a) If C_T is a right m-regular neutrosophic fuzzy matrix and $R(D_T) \subseteq R(C_T^m)$ then, $D_T = D_T X C_T$ for each right m - g inverse X of C_T.

b) If C_F is a right m-regular Neutrosophic fuzzy Matrix and $R(D_F) \subseteq R(C_F^m)$ then, $D_F = D_F X C_F$ for each right m - g inverse X of C_F.

c)) If C_I is a right m-regular Neutrosophic fuzzy Matrix and $R(D_I) \subseteq R(C_I^m)$ then, $D_I = D_I X C_I$ for each right m - g inverse X of C_I.

ii)a) If C_T is a left m-regular Neutrosophic fuzzy Matrix and $C(D_T) \subseteq C(C_T^m)$ then, $D_T = C_T Y D_T$ for each left m - g inverse y of C_T.

b) If C_F is a left m -regular Neutrosophic fuzzy Matrix and $C(D_F) \subseteq C(C_F^m)$ then, $D_F = C_F Y D_F$ for each left m - g inverse y of C_F.

c) If C_I is a left m-regular Neutrosophic fuzzy Matrix and $C(D_I) \subseteq C(C_I^m)$ then, $D_I = C_I Y D_I$ for each left m - g inverse y of C_I.

Proof:

i)a)Since$R(D_T) \subseteq R(C_T^m)$ by lemma (2.5), there exists z such that $D_T = ZC^m{}_T$,
Since $C_T$is right m-regular Neutrosophic Fuzzy Matrix by definition (3.1)
$C_T^m X_T C_T, = C_T^m$, for some $X \in C_r\{1^m\}$.
Hence $D_T = ZC^m{}_T = ZC^m{}_T X C_T = D_T X C_T$
Thus (i)(a) holds. Similarly, we can prove for (i)(b) and (i) (c).

ii)a) Since $C(D_T) \subseteq C(C_T^m)$ by lemma (2.5), there exists u such that $D_T = C^m{}_T U$.
Since $C_T$is left m-regular Neutrosophic Fuzzy Matrix by definition (3.2),
$C_T Y C_T^m = C_T^m$, for some $Y \in C_r\{1^m\}$.
Hence $D_T = C^m{}_T U = C_T Y C_T^m U = C_T Y D_T$
Thus (ii)(a) holds. Similarly, we can prove for (ii)(b) and (ii) (c).

Theorem

For $C, D \in N_n$,with R(C) = R(b) and $R(C^m) = R(D^m)$ then C is right m-regular Neutrosophic Fuzzy Matrix $\Leftrightarrow$ D is right m- regular Neutrosophic Fuzzy Matrix.

Proof:

Let C be a right m-regular Neutrosophic Fuzzy Matrix satisfying $R(D^m) \subseteq R(C^m)$ and$R(C) \subseteq R(D)$
Since $R(D^m) \subseteq R(C^m)$, by lemma (3.7),$D^m = D^m X C$ for each m- g inverse X of C. Since
$R(C) \subseteq R(b)$ by lemma (2.4), C = YB for some $Y \in N_n$.
Substituting for C in $D^m X C$, we get
$B^m = D^m X C = D^m X Y D = D^m Z D$ where XY = Z.
Hence D is a right m – regular Neutrosophic Fuzzy Matrix.
Conversely, if D is a right m-regular Neutrosophic Fuzzy Matrix satisfying $R(C^m) \subseteq R(D^m)$ and $R(D) \subseteq R(C)$, then C is a right m-regular Neutrosophic Fuzzy Matrix can be proved in the same manner. Hence the theorem.

Theorem

For $C, D \in N_n$, with $C(C) \subseteq C(D)$ and $C(C^m) = C(D^m)$ then C is left m-regular Neutrosophic Fuzzy Matrix $\Leftrightarrow$ D is left m- regular Neutrosophic Fuzzy Matrix.

Proof:

The proof is similar to the proof of theorem 3.8.

Therorem

For $C=[C_T, C_F, C_I]$and$D=[D_T, D_F, D_I]\in N_n$ with R(C) = R(D) and $R(C^m) = R(D^m)$ then the following are equivalent:

i) C is a right m-regular Neutrosophic Fuzzy Matrix.
ii) C_T, C_F and C_I are right m-regular Neutrosophic Fuzzy Matrices.
iii) D is a rightm-regular Neutrosophic Fuzzy Matrix.
iv) D_T, D_F and $D_I$are right m-regular Neutrosophic Fuzzy Matrices.

Proof

(i) $\Leftrightarrow$ (ii) and (iii) $\Leftrightarrow$ (iv) are precisely theorem (3.5)

(i) $\Leftrightarrow$ (iii) This follows from theorem (3.8)

Theorem

For $A=[C_T, C_F, C_I]$and$D=[D_T, D_F, D_I]\in N_n$ with C(C) = C(b) and $C(C^m) = C(b^m)$ then the following are equivalent:

i) Cis a left m-regular Neutrosophic Fuzzy Matrix.
ii) C_T, C_F and C_I are left m-regular Neutrosophic Fuzzy Matrices.
iii) D is a leftm-regular Neutrosophic Fuzzy Matrix.
iv) D_T, D_F and $D_I$are left m-regular Neutrosophic Fuzzy Matrices.

Proof

(i) $\Leftrightarrow$ (ii) and (iii) $\Leftrightarrow$ (iv) are precisely theorem (3.6)

(i) $\Leftrightarrow$ (iii) . This follows from theorem (3.9).

CONCLUSION

A certain type of generalized inverse called m-g converse of m-standard fuzzy matrices are considered. These inverses are utilized to tackle the least-squares arrangement of a conflicting arrangement of direct conditions. Different uses of these inverses are to tackle the frameworks of nonlinear conditions, number arrangements of frameworks of conditions and to straight programming.

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RESEARCH ARTICLE

Effectiveness of Dental Health Education in Enhancing the Knowledge, Attitude and Practices Related to Emergency Management of Dental Trauma and Tooth Avulsion among Asha Workers in Mysuru District – An Interventional Study

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ABSTRACT

Dental trauma is one of the commonest of all facial injuries and success of treatment of avulsion depends on how avulsed teeth were managed prior to replantation. To evaluate and compare effectiveness of DHE offered by two different methods in enhancing KAP related to emergency management of dental trauma and tooth avulsion among ASHA workers in Mysuru district. This was an educational interventional study conducted among ASHA workers in Mysuru city. Baseline KAP on emergency management of dental trauma and tooth avulsion were obtained using a questionnaire. Subsequently, selected health centre was randomly assigned into one of the two groups. DHE on "Dental Trauma and Emergency Management of Tooth Avulsion" was offered to all ASHA workers using one of the two methods. Group A was offered DHE physically by a qualified Public Health Dentist with flipcharts. Group B using a recorded video. Post-intervention data collection was done using the same validated questionnaire immediately and 3 months post-intervention. A total of 187 ASHA workers participated with 93 participants in Group A and 94 in Group B. Mean KAP score for all ASHA workers at baseline was 5.36 ± 2.46 which significantly increased to 9.73 ± 0.61 immediately after intervention and 9.67 ± 0.62

3-months following intervention. There was no statistically significant difference between Group A and Group B in mean KAP scores during post-intervention. KAP scores on emergency management of dental trauma and tooth avulsion improved significantly following DHE among ASHA workers.

Keywords: ASHA workers, Dental trauma, Tooth avulsion, Dental Health Education (DHE)

INTRODUCTION

Dental trauma is one of the commonest of all facial injuries. Avulsion is one of the most serious types of dental trauma. Avulsion is the complete displacement of a tooth from its socket and its periodontal ligament with or without the fracture of the alveolar bone. Its prognosis is heavily reliant on first-aid measures and the tendency to access dental care promptly. Being the most serious form of dental trauma, it occurs in society with an incidence rate of 0.5%-16% of all traumatic injuries of permanent dentition [1]. Studies from certain industrialized countries have revealed that the prevalence of dental traumatic injuries is on the increase, ranging from 16-40% among 6-year-old children and 4-33% among 12–14-year-old children [2]. The success of the treatment of avulsion is extremely dependent on how the avulsed teeth were managed prior to replantation. An avulsed tooth should be replanted as soon as humanly possible. The rupture of blood supply causes deterioration in different levels of the pulp and periodontal ligament (PDL) cells. The longer the tooth stays out of the socket, the worse the prognosis becomes. Physical damage to periodontal cells caused by negligent handling, contamination of avulsed teeth, and their storage in an inappropriate medium can also impair cell viability, affecting periodontal healing and the long-term survival of replanted teeth. Maxillary central and lateral incisors are the teeth that are more prone to dental avulsion due to trauma among children. These teeth have high aesthetic importance. About 0.5%–18.3% of dental traumatic injuries have resulted in avulsion of the permanent maxillary incisor teeth [3-5].

Lack of knowledge on what to be done as an emergency first aid service during dental trauma and tooth avulsion among rural populations leads to the loss of many teeth among children which otherwise could be saved with necessary first aid measures. ASHA (Accredited Social Health Activists) are basically community health workers at the village level under National Rural Health Mission (NRHM). The Ministry of Health and Family Welfare (MoHFW), Government of India, describes them as health activist(s) in the community who will create awareness on health and its social determinants. They also mobilize the community towards local health planning facilitating increased utilization and accountability of the existing health service [6]. Knowledge among the rural population can be enhanced through ASHA workers. A study to evaluate the effectiveness of dental education (DHE) in increasing the knowledge, attitude, and practices related to emergency management of dental trauma and tooth avulsion among school teachers and students was found to be effective [7]. An ASHA worker with knowledge on first aid services to be undertaken during dental trauma and tooth avulsion is expected to play a substantial role in reducing the negative consequences of such injuries. Published literature on the effectiveness of such dental health education programs aimed at enhancing the knowledge, attitude, and practices related to emergency management of dental trauma and tooth avulsion among ASHA workers in the Mysuru district was not existing. Hence, this interventional study was designed to evaluate the effectiveness of dental health education (DHE) in enhancing the knowledge, attitude, and practices related to emergency management of dental trauma and tooth avulsion among ASHA workers in the Mysuru district.

MATERIALS AND METHODS

This was an educational interventional study conducted among ASHA workers in Mysuru district, Karnataka, India over a period of 6 months from October 2021 to March 2022. Ethical Clearance was obtained from the Institutional Ethical Committee (IEC) vide reference number: JSS/DCH/IEC/45/2020).

Sample size estimation and sampling

The sample size was estimated using nMaster software for hypothesis testing between two means with equal variances assumed. It was computed to be 74 at an assumed mean difference of 0.6 at 80% power and 5% level of significance. However, the sample size was rounded off to 90 per group anticipating 20% non-response. A two-stage sampling technique was adopted to recruit the required number of ASHA into the study. Mysuru is a district with 8 taluks in Karnataka, India. One out of eight taluks was selected using the lottery method of simple random sampling in the first stage. The list of primary health centres (PHCs) and community health centres (CHCs) in the selected taluk was collected from the office of the District Medical and Health Officer, Mysuru district. Mysuru taluk had 34 PHCs and 1 CHC. The health centres (PHCs and CHCs) were segregated into rural and urban health centres. The total number of urban and rural health centres were 20 and 15 respectively. All the PHCs and CHC in urban areas were considered and five out of 15 rural PHCs were selected using a simple random sampling technique in the second stage. The reason for selecting all PHCs and CHC in urban area was that the number of ASHAs attached to urban centres were less compared those attached to rural centres. Details of all the ASHA workers working in these selected urban and rural Primary Health Centres, Community Health Centres, and Subcentres in the Mysuru taluk were collected from District Medical and Health Office after getting the required permissions from the District Health Officer. Permission to carry out the study in selected PHCs and CHCs were also obtained from the concerned Medical Officers (MO) of the PHCs and CHCs. Written informed consent in the local language (Kannada) was obtained from ASHA workers before the start of the study. All the ASHA workers in the selected health centres who fulfilled the following eligibility parameters were considered for the study.

Inclusion criteria:

- ASHA workers who offered their consent to participate.
- ASHA workers who were able to read and write in Kannada.

Exclusion criteria:

- ASHA workers who were absent at baseline or during the follow-up examinations
- Incompletely filled questionnaires

The schedule for data collection was shared with the ASHA workers through the concerned Medical officer and they were invited and requested to take part in the research.

Development and Validation of intervention tool

The tool for data collection was prepared and validated in a previous pilot study which was conducted in selected health centres in the Mysuru district (Reference – Unpublished article). These centres which were previously involved were not considered in the present study. The tool had ten items for eliciting the knowledge, attitude, and practices pertaining to emergency first aid management of dental trauma and tooth avulsion.

Collection of baseline data

Baseline knowledge and practices on emergency management of dental trauma and tooth avulsion among ASHA workers were obtained using that questionnaire in local (Kannada) language on the scheduled day by the principal investigator. After obtaining baseline data, each health centre was randomly assigned into one of the two groups using a coin toss by the coordinator of the research. Two different methods of dental health education (DHE) were adopted in these two groups.

Dental Health Education Intervention

DHE on "Dental Trauma and Emergency Management of Tooth Avulsion" was offered to all the ASHA workers either using group A method or group B method. DHE was extended to nurses of the PHC's and CHC's who were present at the time of intervention as they were voluntarily interested. However, the data from ASHA only was considered for analysis.

Group A
DHE was offered physically by a qualified Public Health Dentist in the premises of their health centre on the scheduled date with flipcharts.

Group B
DHE was offered using a recorded video where DHE was offered by a public health dentist with slide show presentation using an LCD projector. DHE material contained the same information in both the intervention groups. Both the groups were given a booklet that contained information on emergency management of dental trauma and tooth avulsion in local language (Kannada). The educational booklet was designed with text and pictures for easy understanding of dental trauma, tooth avulsion, first-aid measures for avulsed tooth, replantation, storage media, do's and don'ts in case of dental injury. All the ASHA workers were asked to get their doubts (if any) clarified after the DHE.

Post-intervention data collection
Post-intervention data collection was done using the same validated questionnaire immediately and 3 months after the intervention by the same investigator who collected baseline data.

Data analysis
The Statistical Package for the Social Sciences, version 22.0, was used (IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp. USA). The correct response for each item in the questionnaire was coded as 1, while the incorrect/don't know response was coded as zero. Knowledge attitude and practices (KAP) related 10 items were pooled together to determine total KAP score for each participant. Mean KAP scores between different groups at each time interval was compared using independent sample t test and between different time intervals in each group was compared using the Repeated Measures Analysis of Variance.

RESULTS

A total of 187 ASHA workers participated in the study with 93 participants in Group A and 94 in Group B. 73 participants from urban and 114 participants from rural health centres. There was no statistically significant difference in the age distribution of participants in relation to geographic location in each group (Table 1). The mean KAP score for all the ASHA put together at baseline was 5.36 ± 2.46. The baseline mean KAP score was significantly higher among ASHA in rural areas (5.87 ± 1.94) compared to those in urban areas (4.58 ± 2.98) ($p = <0.001$, Table 2). These results were true when a separate comparison was undertaken in group B. In group A, ASHA in urban areas had a significantly higher mean KAP score (5.52 ± 2.87) compared to those in rural areas (5.32 ± 1.90) ($p = 0.006$, Table 2). There was no statistically significant difference in the mean KAP score at baseline among those aged less than 40 years (5.56 ± 2.33) in comparison with those aged more than 40 years (4.89 ± 2.69) ($p = 0.090$, Table 2). There was no statistically significant difference between Group A and Group B in mean KAP scores at baseline ($p = 0.759$). This was significant when separate subgroup analysis was made in urban ($p = 0.003$) and rural areas ($p = 0.004$). (Table 2)
The mean KAP score among ASHA in rural and urban areas immediately following DHE were 9.74 ± 0.54 and 9.71 ± 0.71 respectively with no significant difference between them ($p = 0.792$, Table 3). These results were true even when a separate comparison was done in groups A and B as well as among those aged less than and more than 40 years in each group (Table 3). There was no statistically significant difference between Group A and Group B in mean KAP scores immediately after the intervention ($p = 0.700$). This was insignificant even when separate subgroup analysis was made in urban ($p = 0.503$) and rural areas ($p = 0.872$). (Table 3).

The mean KAP score among ASHA in rural and urban areas three months following DHE were 9.59 ± 0.67 and 9.60 ± 0.68 respectively with no significant difference between them ($p = 0.883$, Table 4). These results were true even when a separate comparison was done in groups A and B as well as among those aged less than and more than 40 years in each group (Table 4). There was no statistically significant difference between Group A and Group B in mean KAP

scores three months after the intervention (p = 0.120). This was insignificant even when separate subgroup analysis was made in urban (p = 0.517) and rural areas (p = 0.141). (Table 4) . The increase in mean KAP scores between baseline to follow up examinations was statistically significant in both groups. These results were true even when a separate comparison was made in relation to geographical location and in different age groups. The posthoc analysis revealed a significant difference between baseline and other two post-intervention time periods. However, the change in mean KAP values between immediately and three months following intervention was not statistically significant (Table 5).

DISCUSSION

Health promotion is the "*the process of enabling people to increase control over, and to improve health*." [8]. Primary prevention includes health promotion by health education [9]. Health education is one of the most cost-effective interventions [8]. First aid is the preliminary emergency care taken at the scene of an accident or during any mishappening before taking the victim to a medical professional. The first aid measures can be provided by any individual irrespective of their professional background if he / she has a basic training. Lay population are not much aware of certain first aid measures to be undertaken during dental trauma and tooth avulsion. They in fact are not aware that they could give first aid in case of any dental injury. Tooth avulsion is one such emergency situation in dentistry wherein prompt actions in those critical times can markedly enhance the prognosis of treatment further before consulting adentist. Literature which focused on assessing knowledge, attitudes and practices related to emergency management of dental trauma and tooth avulsion among school students and teachers were available [10-12] Some studies have even evaluated the impact of health education interventions aimed at improving knowledge, attitudes and practices related to emergency management of dental trauma and tooth avulsion among school population [13-24]. However, studies evaluating the KAP on emergency management of dental trauma and tooth avulsion as well the impact of DHE in changing KAP among ASHA workers in India are non-existent. The NRHM comprises a combination of several strategies/schemes namely— Janani Suraksha Yojana (JSY)] for institutional deliveries; an emergency transport mechanism (Call Ambulance '108' initiative of Emergency Management, Sanitation and Nutrition Committees (VHSNC), and the establishment of a new cadre of community health volunteers [Accredited Social Health Activists (ASHA)] in all Indian communities.

An ASHA is a community-selected woman who lives in the community and is trained, deployed, and supported to serve in her own village to improve people's health by assuring their access to healthcare services. Her job responsibilities include being a link-worker (facilitating access to healthcare facilities and accompanying women and children), a community health worker (stocking essential medicines and treating minor ailments), and a health activist (creating health awareness and mobilising the community for change in health status) [25-27]. Tothe best of our knowledge, this is the first study conducted on primary health care workers regarding the emergency management of dental trauma and tooth avulsion. DHE by qualified public health dentists to all the population, although is an idealistic necessity; it is not a realistic option. Literature indicates that trained school teachers could be effectively utilized to bring about positive, healthy practices and lifestyles among students [28,29]. This interventional study focused on evaluating the feasibility and effectiveness of the DHE by evaluating their change in knowledge, attitude and practices at three different intervals (baseline, immediately post-intervention and 3 months post-intervention). Overall mean KAP score of ASHA workers has significantly increased from 5.36 ± 2.46 at baseline to 9.73 ± 0.61 immediately post-intervention and 9.59 ± 0.67 at three months post-intervention (p-value <0.001). This could be attributed to DHE that was delivered in such a way that it was easy to understand the steps in emergency management of dental trauma and tooth avulsion. The DHE included a stepwise process to be undertaken with special emphasis on proper handling of the tooth, reimplantation, storage medium, and ideal duration within which the first aid should be undertaken. The supplemental booklet given to ASHA workers in the local language also could be a useful tool for conveying key basic information, enhancing KAP, and assisting in the constant revision of facts provided during DHE. These results are in par with the results of the study done by Srilatha et al., on school teachers regarding KAP on dental trauma and tooth avulsion where the KAP increased from 8.39 ± 2.59 at baseline to

13.79 ± 1.12 immediately after health education and 13.87 ± 1.17 3 months after health education [30]. Our results were consistent with the study by Pujitha et al., who found an improvement in knowledge levels among teachers in rural areas from 19.2% at baseline to 82.4% following health education. The improvement among urban teachers' knowledge levels was from 25.2% at baseline to 82.9% after health education [15]. Teachers' awareness of permanent tooth replantation had improved, according to Karande et al [18]. In their study, the knowledge score increased from 16% at the baseline to 95% three months following educational intervention. Andersson et al. found an improvement in knowledge scores following health education among Kuwaiti school children similar to the results of our study [31].

There was no significant difference in the mean KAP scores among participants who received two different health education methods (flip chart and slide show) immediately after intervention (p = 0.700) and three months after the intervention (p = 120) suggesting that both methods were equally effective. These results were consistent with results of a study by Srilatha et al [30]. The study demonstrated that simple DHE using even the recorded video can significantly enhance the KAP among ASHA workers on emergency management of dental trauma and tooth avulsion.

Novelty

The study was undertaken on ASHA workers who are considered front line health workers in primary health care system in India. The study is a step towards integrating oral health components into primary health care system in India. The DHE methods chosen were simple, realistic and feasible. Comparison of DHE offered by public health dentist in person with that offered using recorded video demonstrated that both are equally effective. This finding will facilitate in developing IEC material for training ASHA workers using such recorded videos for promotion of other oral health related information. This is the first of its kind study undertaken to assess KAP on dental trauma and tooth avulsion among ASHA workers in India. An educated ASHA can play a substantial role in initiating first aid services during dental trauma and tooth avulsion in her community.

Limitations

The study was undertaken among ASHA workers in Mysuru taluk. A wider representation from other taluks would have enhanced generalizability. However, the time and logistic constraints compelled us to undertake the study in one taluk of Mysuru district.

CONCLUSION

KAP scores on emergency management of dental trauma and tooth avulsion improved significantly following DHE among ASHA workers. DHE offered by public health dentist in person using the flipchart was equally effective compared to that offered using recorded videos.

Way Forward

The study needs to be expanded for all ASHA workers in the district and state as part of integrating oral health care into primary health care system in a phase wise manner using private public partnership.

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Conflicts of interest
There are no conflicts of interest.

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Table 1: Age distribution of ASHA workers in two different groups

Group	Geographic Location	< 40 years N (%)	41 years and above N (%)	Total N (%)
Group A	**Urban**	26 (68.4)	12 (31.6)	38 (100)
	Rural	39 (70.9)	16 (29.1)	55 (100)
	Total	65 (69.9)	28 (30.1)	93 (100)
Statistical inference	X^2 value: 0.06 df value: 1 p-value: 0.797			
Group B	**Urban**	22 (62.9)	13 (37.1)	35 (100)
	Rural	45 (76.3)	14 (23.7)	59 (100)
	Total	67 (71.3)	27 (28.7)	94 (100)
Statistical inference	X^2 value: 1.931 df value: 1 p-value: 0.238			
Overall	**Urban**	48 (65.8)	25 (34.2)	73 (100)
	Rural	84 (73.7)	30 (26.3)	114 (100)
	Total	132 (70.6)	55 (29.4)	187 (100)
Statistical inference Group Vs Geographic location	X^2 value: 1.348 df value: 1 p-value: 0.246			

Table 2: Mean KAP score at baseline among ASHA workers in different groups in relation to age and geographic location

Group	Geographic Location	< 40 years Mean±SD	40 years and above Mean±SD	Overall Mean±SD	Statistical inference
Group A	Urban	5.77 ± 2.67	5.08 ± 3.35	5.52 ± 2.87	t-value: 0.679 df: 36 p value: 0.501
	Rural	5.53 ± 1.94	4.81 ± 1.76	5.32 ± 1.90	t-value: 1.291 df: 53 p value: 0.202
	Total	5.63 ± 2.25	4.98 ± 2.51	5.41 ± 2.33	t-value: 1.34 df: 91 p value: 0.185
Statistical inference		t-value: 0.403 df: 63 p value: 0.688	t-value: 0.278 df: 26 p value: 0.783	t-value: 0.455 df: 91 p value: 0.006	
Group B	Urban	3.45 ± 2.42	3.61 ± 3.18	3.51 ± 2.68	t-value: -0.169 df: 33 p value: 0.867
	Rural	6.49 ± 1.74	6.00 ± 2.22	6.37 ± 1.85	t-value: 0.859 df: 57 p value: 0.394
	Total	5.49 ± 2.44	4.85 ± 2.93	5.30 ± 2.59	t-value: 1.086 df: 92 p value: 0.280
Statistical inference		t-value: -5.869 df: 65 p value: 0.000	t-value: -2.275 df: 25 p value: 0.035	t-value: -6.095 df: 92p value: 0.000	
Overall	Urban	4.71 ± 2.79	4.32 ± 3.27	4.58 ± 2.98	t-value: 0.531 df: 71 p value: 0.597
	Rural	6.05 ± 1.88	5.37 ± 2.04	5.87 ± 1.94	t-value: 1.660 df: 112 p value: 0.100
	Total	5.56 ± 2.33	4.89 ± 2.69	5.36 ± 2.46	t-value: 1.704 df: 185 p value: 0.090
Statistical inference		t-value: -3.281 df: 130 p value: 0.001	t-value: -1.446 df: 53 p value: 0.154	t-value: -3.616 df: 185 p value: 0.000	
Statistical inference	Group A Vs Group B in urban areas		t-value: 3.126	df: 71	p value: 0.003
	Group AVs Group B in rural areas		t-value: -2.967	df: 112	p value: 0.004
	Group A Vs Group B in overall		t-value: 0.307	df: 185	p value: 0.759

Table 3: Mean KAP score immediately post intervention among ASHA workers in different groups in relation to age and geographic location

Group	Geographic Location	< 40 years Mean±SD	40 years and above Mean±SD	Overall Mean±SD	Statistical inference
Group A	Urban	9.65 ± 0.74	9.66 ± 0.65	9.65 ± 0.70	t-value: -0.051 df: 36 p value: 0.959
	Rural	9.66 ± 0.62	9.93 ± 0.25	9.74 ± 0.55	t-value: -1.681 df: 53 p value: 0.025
	Total	9.66 ± 0.66	9.82 ± 0.47	9.71 ± 0.61	t-value: -1.146 df: 91 p value: 0.255
Statistical inference		t-value: -0.75 df: 63 p value: 0.940	t-value: -1.528 df: 26 p value: 0.139	t-value: -0.669 df: 91 p value: 0.505	
Group B	Urban	9.68 ± 0.89	9.92 ± 0.27	9.74 ± 0.73	t-value: -0.942 df: 33 p value: 0.353

	Rural	9.75 ± 0.08	9.64 ± 0.49	9.72 ± 0.55	t-value: 0.664 df: 57 p value: 0.509
	Total	9.73 ± 0.68	9.77 ± 0.42	9.74 ± 0.62	t-value: -0.046 df: 92 p value: 0.745
Statistical inference		t-value: -0.410 df: 65 p value: 0.683	t-value: 1.788 df: 25 p value: 0.086	t-value: 0.320 df: 92 p value: 0.750	
Overall	**Urban**	9.67 ± 0.80	9.80 ± 0.50	9.71 ± 0.71	t-value: -0.752 df: 71 p value: 0.454
	Rural	9.71 ± 0.59	9.80 ± 0.407	9.74 ± 0.54	t-value: -0.732 df: 112 p value: 0.466
	Total	9.70 ± 0.67	9.80 ± 0.44	9.73 ± 0.61	t-value: -1.039 df: 185 p value: 0.300
Statistical inference		t-value: -3.88 df: 130 p value: 0.699	t-value: 0.000 df: 53 p value: 1.000	t-value: - 0.264 df: 185 p value: 0.792	
Statistical inference	**Group AVs Group B in urban areas**	t-value: -0.674 df: 71 p value: 0.503			
	Group AVs Group B in rural areas	t-value: 0.161 df: 112 p value: 0.872			
	Group AVs Group B in overall	t-value: -0.386 df: 185 p value: 0.700			

Table 4: Mean KAP score 3-months following intervention among ASHA workers in different groups in relation to age and geographic location

Group	**Geographic Location**	**< 40 years Mean±SD**	**40 years and above Mean±SD**	**Overall Mean±SD**	**Statistical inference**
Group A	**Urban**	9.61 ± 0.63	9.41 ± 0.90	9.55 ± 0.72	t-value: 0.782 df: 36 p value: 0.439
	Rural	9.41 ± 0.75	9.68 ± 0.60	9.40 ± 0.71	t-value: -0.195 df: 53 p value: 0.1599
	Total	9.49 ± 0.70	9.57 ± 0.74	9.52 ± 0.71	t-value: -0.486 df: 91 p value: 0.6289
Statistical inference		t-value: 1.144 df: 63 p value: 0.257	t-value: -0.954 df: 26 p value: 0.349	t-value: 0.407 df: 91 p value: 0.685	
Group B	**Urban**	9.68 ± 0.64	9.61 ± 0.65	9.65 ± 0.63	t-value: 0.293 df: 33 p value: 0.771
	Rural	9.68 ± 0.66	9.64 ± 0.49	9.67 ± 0.62	t-value: 0.238 df: 57 p value: 0.813
	Total	9.68 ± 0.65	9.62 ± 0.56	9.67 ± 0.62	t-value: 0.395 df: 92 p value: 0.693
Statistical inference		t-value: -0.041 df: 65 p value: 0.683	t-value: -0.124 df: 25 p value: 0.902	t-value: -0.154 df: 92 p value: 0.878	

Overall	**Urban**	9.65 ± 0.63	9.52 ± 0.77	9.60 ± 0.68	t-value: 0.746 df: 71 p value: 0.458
	Rural	9.56 ± 0.71	9.67 ± 0.54	9.59 ± 0.67	t-value: -0.744 df: 112 p value: 0.459
	Total	9.59 ± 0.68	9.60 ± 0.65	9.59 ± 0.67	t-value: -0.084 df: 185 p value: 0.934
Statistical inference		t-value: 0.693 df: 130 p value: 0.490	t-value: -0.824 df: 53 p value: 0.414	t-value: 0.148 df: 185 p value: 0.883	
Statistical inference	**Group AVs Group B in urban areas**	t-value: -0.652 df: 71 p value: 0.517			
	Group A Vs Group B in rural areas	t-value: -1.484 df: 112 p value: 0.141			
	Group A Vs Group B in overall	t-value: -1.563 df: 185 p value: 0.120			

Table 5: Change in mean KAP score between baseline and post intervention follow ups.

Group	Geographic Location	Baseline Mean±SD	Immediately after DHE Mean±SD	Three months after DHE Mean±SD	Statistical inference	Posthoc
Group A	**Urban**	5.52 ± 2.87	9.65 ± 0.70	9.55 ± 0.72	F-value: 78.43 df: 2 p value: <0.001	BL Vs I_DHE: <0.001 BL Vs T_DHE: < 0.001 I_DHE Vs_T_DHE: 0.401
	Rural	5.32 ± 1.90	9.74 ± 0.55	9.40 ± 0.71	F-value: 226.87 df: 2 p value:<0.001	BL Vs I_DHE: <0.001 BL Vs T_DHE: < 0.001 I_DHE Vs_T_DHE: 0.015
	Total	5.41 ± 2.33	9.71 ± 0.61	9.52 ± 0.71	F-value: 280.17 df: 2 p value: <0.001	BL Vs I_DHE: <0.001 BL Vs T_DHE: < 0.001 I_DHE Vs_T_DHE: 0.015
Group B	**Urban**	3.51 ± 2.68	9.74 ± 0.73	9.65 ± 0.63	F-value: 182.10 df: 2 p value: <0.001	BL Vs I_DHE: <0.001 BL Vs T_DHE: < 0.001 I_DHE Vs_T_DHE: 0.379
	Rural	6.37 ± 1.85	9.72 ± 0.55	9.67 ± 0.62	F-value: 169.15 df: 2 p value: <0.001	BL Vs I_DHE: <0.001 BL Vs T_DHE: < 0.001 I_DHE Vs_T_DHE: 0.643
	Total	5.30 ± 2.59	9.74 ± 0.62	9.67 ± 0.62	F-value: 257.67 df: 2 p value:<0.001	BL Vs I_DHE: <0.001 BL Vs T_DHE: < 0.001 I_DHE Vs_T_DHE: 0.373
	Urban	4.58 ± 2.98	9.71 ± 0.71	9.60 ± 0.68	F-value: 215.61 df: 2 p value:<0.001	BL Vs I_DHE: <0.001 BL Vs T_DHE: < 0.001 I_DHE Vs_T_DHE: 0.219

Overall	**Rural**	5.87 ± 1.94	9.74 ± 0.54	9.59 ± 0.67	F-value: 376.34 df: 2 p value: <0.001	BL Vs I_DHE: <0.001 BL Vs T_DHE: < 0.001 I_DHE Vs_T_DHE: 0.049
	Total	5.36 ± 2.46	9.73 ± 0.61	9.59 ± 0.67	F-value: 536.84 df: 2 p value: <0.001	BL Vs I_DHE: <0.001 BL Vs T_DHE: < 0.001 I_DHE Vs_T_DHE: 0.020

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RESEARCH ARTICLE

An Effective Network Classification Based on the TCP and UDP

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ABSTRACT

Network traffic investigation turns out to be increasingly more vital in the IP network framework as how much IP parcels sent on the Internet out of nowhere of time increments tremendously. A careful comprehension of the IP traffic will assist us with better planning our organization geography and use transfer speed all the more actually. According to the viewpoint of safety, it can likewise shield our framework from assaults, like interruptions, assuming that we see better the organization traffic as opposed to treating them inside a black box. Gullible bayes calculation utilized for order reason. we propose another structure, Traffic Classification utilizing Correlation data (TCC), to resolve the issue of not very many preparation tests. The relationship data in network traffic can be utilized to further develop the order precision successfully. In the pre-handling, the framework catches IP bundles crossing a PC organization and builds traffic streams by IP header examination. A stream comprises of progressive IP bundles having a similar 5-tuple: {src, ip, src port, dst ip, dst port, protocol}. From that point forward, a bunch of measurable elements are extricated to address each stream. Include determination expects to choose a subset of significant highlights for building hearty characterization models. Stream relationship investigation is proposed to correspond data in the rush hour gridlock streams. At long last, the vigorous traffic arrangement motor orders traffic streams into application-based classes by considering all data of factual elements and stream connection.

Keywords: Network traffic, IP traffic, traffic streams, stream connection.

INTRODUCTION

An organization traffic examination programming apparatus, which gives looking, perception, and pre-handling capacities with an easy-to-use GUI carried out in Java language. Inside the tremendous organization traffic

information gathered, a client can recognize a specific bundle utilizing different looking through capacities gave. Representation presents the examined bring about an alternate setting to additional improve the examination. The GUI in Java permits the device to be utilized in various stages. This device is tried and shown through a few genuine organization datasets. Server farm administrators should have the option to accomplish high usage of server and organization limit. For proficient and adaptable allotment, administrators ought to have the option to spread a virtual organization occurrence across waiters in any rack in the server farm. It ought to likewise be feasible to relocate register responsibilities to any server anyplace in the organization while holding the responsibility's locations. In organizations of many sorts (e.g., IP subnets, MPLS VPNs, VLANs, and so on) moving servers somewhere else in the organization might require extending the extent of a part of the organization (e.g., subnet, VPN, VLAN, and so on) past its unique limits. While this should be possible, it requires possibly complex organization design changes and may (at times - e.g., a VLAN or L2VPN) struggle with the craving to bound the size of transmission spaces. Likewise, when VMs relocate, the actual organization (e.g., access records) may should be reconfigured which can be tedious and mistake inclined. A significant use case is cross-unit extension. A case ordinarily comprises of at least one racks of servers with related organization and capacity network. An inhabitant's virtual organization might get going on a unit and, because of extension, require servers/VMs on different cases, particularly the situation when different units are not completely using every one of their assets. This utilization case expects that virtual organizations length numerous units to give network to its inhabitant's servers in general/VMs. Such development can be challenging to accomplish while inhabitant addressing is attached to the tending to utilized by the underlay organization or when the extension expects that the extent of the fundamental C-VLAN grow past its unique unit limit.

Existing System

The administered traffic characterization techniques investigate the managed preparing information and produce an induced capacity which can anticipate the result class for any testing stream. In regulated rush hour gridlock grouping, adequate directed preparing information is an overall supposition. To resolve the issues endured by payload-based traffic characterization.

Disadvantages

- Not recognize association less conventions
- Arrangement in light of convention is troublesome
- Less security.

Proposed System

We propose an original non-parametric methodology which consolidates connection of traffic streams to further develop the characterization execution. We give a nitty gritty examination on the clever characterization approach and its exhibition benefit from both hypothetical and experimental viewpoints. The presentation assessment shows that the traffic grouping utilizing not many preparation tests can be altogether worked on by our methodology.

Advantages of Proposed System

- An original nonparametric methodology, TCC, was proposed to examine relationship data in genuine rush hour gridlock information and integrate it into traffic order.
- Semi-administered information digging for handling network bundles.

RELATED WORK

Analyzing the Data set

An informational index (or dataset) is an assortment of information, ordinarily introduced in plain structure. Every segment addresses a specific variable. Each column compares to a given individual from the informational collection being referred to. It records values for every one of the factors, like level and weight of an item or upsides of irregular numbers. Each worth is known as a datum. The informational index might contain information for at least one individuals, comparing to the quantity of columns. The qualities might be numbers, like genuine numbers or

numbers, for instance addressing an individual's level in centimeters, however may likewise be ostensible information (i.e., not comprising of mathematical qualities), for instance addressing an individual's identity. All the more for the most part, values might be of any of the sorts depicted as a degree of estimation. For every variable, the qualities will ordinarily all be of a similar kind.

Pre-processing

In this module we will get the organization parcel and concentrate ascribes utilizing the WinPcap and Jpcap. In data innovation, a parcel is a designed unit of information conveyed by a bundle mode PC organization. PC correspondences connects that don't uphold bundles, for example, customary highlight point media communications joins, basically send information as a progression of bytes, characters, or pieces alone. At the point when information is organized into bundles, the bitrate of the correspondence medium can all the more likely be divided between clients than if the organization were circuit exchanged. By utilizing bundle exchanged systems administration it is additionally more enthusiastically to ensure a most reduced conceivable bitrate. A parcel comprises of two sorts of information: control data and client information (otherwise called payload). The control data gives information the organization needs to convey the client information, for instance: source and objective locations, blunder identification codes like checksums, and sequencing data. Regularly, control data is tracked down in bundle headers and trailers, with client information in between. Different interchanges conventions utilize various shows for recognizing the components and for organizing the information. In Binary Synchronous Transmission, the parcel is designed in 8-digit bytes, and exceptional characters are utilized to delimit the various components. Different conventions, similar to Ethernet, lay out the beginning of the header and information components by their area comparative with the beginning of the bundle. A few conventions design the data at a digit level rather than a byte level. A great relationship is to believe a bundle to resemble a letter: the header resembles the envelope, and the information region is anything the individual puts inside the envelope. A distinction, in any case, is that a few organizations can break a bigger bundle into more modest parcels when fundamental (note that these more modest information components are as yet designed as parcels). An organization configuration can accomplish two significant outcomes by utilizing parcels: mistake location and various host tending to.

WinPcap

WinPcap is an open-source library for bundle catch and organization investigation for the Win32 stages. Most systems administration applications access the organization through broadly utilized working framework natives like attachments. It is not difficult to get to information on the organization with this methodology since the working framework adapts to the low-level subtleties (convention taking care of, bundle reassembly, and so forth) and gives a natural connection point that is like the one used to peruse and compose records.

Jpcap

Jpcap is a Java class bundle that permits Java applications to catch as well as send parcels to the network. Jpcap depends on libpcap/winpcap and Raw Socket API. In this manner, Jpcap should work on any OS on which libpcap/winpcap has been executed. Presently, Jpcap has been tried on FreeBSD 3.x, Linux RedHat 6.1, Fedora Core 4, Solaris, and Microsoft Windows 2000/XP.

Data mining using binary classifier (c4 Algorithm)

Binary classifiers are created for each class of occasion involving important elements for the class and grouping calculation. Binary classifiers are gotten from the preparation test by thinking about all classes other than the ongoing class as other, e.g., Co normal will think about two classes: typical and other. The reason for this stage is to choose various elements for various classes by applying the data gain or gain proportion to recognize significant highlights for every parallel classifier. Additionally, applying the data gain or gain proportion will return every one of the elements that contain more data for isolating the ongoing class from any remaining classes. The result of this group of twofold classifiers will be concluded utilizing assertion work in light of the certainty level of the result of individual parallel classifiers

System Architecture
Above figure shows the architecture of the system

CONCLUSIONS

Parcel analysis has been displayed as a methodology that works on the cutting edge by producing bundle channels that consolidate a large portion of the ideal properties as far as handling speed, memory utilization, adaptability and straightforwardness in indicating convention organizes and separating rules, compelling channel synthesis, and low run-time upward for wellbeing authorization. The advancement of the channel generator and the experimental outcomes support the practicality of our cases. We have planned, prototyped, and assessed SPAF, a parcel.

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3. Energy Efficient Exact Matching for Flow Identification with Cuckoo Affinity Hashing "P. Reviriego, S. Pontarelli, and J. A. Maestro".
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5. Internet Traf_c Classi_cation Using Bayesian Analysis Techniques "Andrew W. Moore University of Cambridge andrew.moore@cl.cam.ac.uk Denis Zuevy University of Oxford denis.zuev@maths.ox.ac.uk".
6. Internet Traffic Classification Demystified: On the Sources of the Discriminative Power " Yeon-sup Lim University of Massachusetts AmherstMA, USA ylim@cs.umass.edu Hyun-chul Kim Seoul National University Seoul, Koreahkim@mmlab.snu.ac.kr Jiwoong Jeong Seoul National University Seoul".
7. Internet Traffic Classification Demystified: Myths, Caveats, and the Best Practices "Hyunchul Kim CAIDA and Seoul National University hkim@mmlab.snu.ac.kr kc claffy CAIDA, UC San Diego kc@caida.org Marina Fomenkov CAIDA, UC San Diego marina@caida.org".
8. Internet Traffic Classification Using Hidden Naïve Bayes Model "Fatemeh Ghofrani, Azizollah Jamshidi, Alireza Keshavarz-Haddad School of Electrical and Computer Engineering, Shiraz University, Shiraz, Iran"
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10. Classification of Internet Users using Discriminant Analysis and Neural Networks "Ant´onio Nogueira, M. Ros´ario de Oliveira, Paulo Salvador∗, Rui Valadas and Ant´onio Pacheco University of Aveiro / Institute of Telecommunications, Campus de Santiago, 3810-193 Aveiro, Portugal e-mail: nogueira@av.it.pt, salvador@av.it.pt,rv@det.ua.pt"

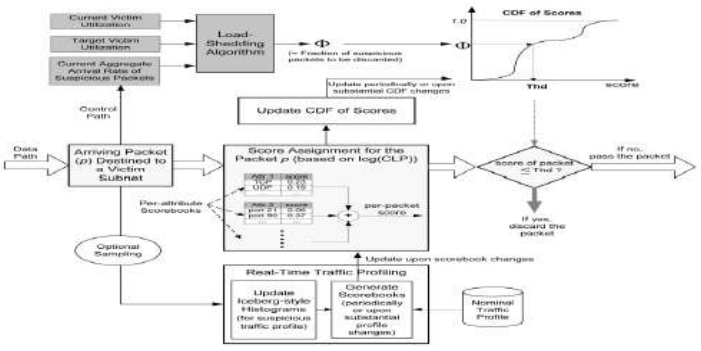

Fig:1 Above figure shows the architecture of the system

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RESEARCH ARTICLE

Technology Development for Microbial Conversion of Water Hyacinth to Bio – Compost and its Effect on the Growth and Yield of Cucumber

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ABSTRACT

Water Hyacinth (*Eichhornia crassipes Mart.*) is one of the important aquatic weeds found all over the world. Several methods have been adopted to eradicate it but with little success. The weed has high content of the nutrients absorbed from its environment. Hence there is need to assess the potential of utilizing the weed for commercial purposes such as compost to substitute the use of inorganic fertilizers which contribute to climate change. The objective of the study was to evaluate the effects of water hyacinth compost prepared using different treatments on the growth and yield of common cucumber. The water hyacinth compost is prepared using effective microorganisms (EM).The EM contains the consortium of three strains *viz*., *Cellulomonas sp, Trichoderma sp and Penicillium sp*.. The effect of compost on crop production was assessed by applying the compost to common cucumber under field conditions. The experiments were laid out in a Randomized Complete Block Design with eight treatments and three replications. Application of water hyacinth compost and NPK significantly influenced the growth of common Cucumber. The best performance of the number of fruit ,fruit weight and fruit yield were recorded when the soil was amended with water hyacinth compost prepared with EM .The yield parameters such as individual fruit weight and total yield of fruits were significantly influenced when the soil was amended with biocompost. The present resultsrevealed that water hyacinth which is locally available and in large quantities can be composted to prepare organic fertilizers and effectively used as an organic soil amendment to restore soil fertility and increase common cucumber production.

Keywords: Water hyacinth, compost, cucumber, *Cellulomonas* sp,*Trichoderma* sp, *Penicillium* sp.

INTRODUCTION

Biomass generated from aquatic ecosystem includes water hyacinth (*Eichhornia sp*), *Ipomeasp*. which are available in huge quantities. Plant nutrient rich manures like farm yard manure and poultry manure are generated from livestock management sectors. Therefore, these organics need to be recycled and put to productive use. This also helps us to overcome the resource constraint which hampers the growth. In view of these facts greater attention is being paid in developing composting technology. The water hyacinth, *Eichhornia crassipes*, is a free floating aquatic weed originating from South America. It can be recognized by its large swollen leaves and violet flowers arranged in spikes. Water hyacinth is a native of the Amazon River, most likely from Brazil (Penfound and Earle 1948). Mankind introduced water hyacinth all over the world because of its beautiful appearance. The water hyacinth could however not be controlled by man and spread all over the tropics and sub tropics due to its fast reproduction and lack of natural enemies (Luo *et al*. 2011). The water hyacinth can reproduce through vegetative and sexual means; the plant is very difficult to control (Gunnarsson and Petersen 2007).Fresh water hyacinth plant contains a large amount of moisture (92.8%); ash content 417 - g kg-1; pH- 8.1; total organic carbon - 338 g kg-1; total nitrogen - 9.5 g kg-1 ; C:N ratio - 36:1; total potassium 9.7 g kg-1 and phosphorus - 5.4 g kg-1 (Ayesha and Padmaja, 2010). The modern concept of environmental management is based on the recycling of waste and composting is a safe form of treatment of some waste and the reclamation of the nutrients contained in them (Iranzo *et al*., 2004). During the last few years, composting has gained wide acceptance as a key component of integrated solid waste and aquatic weeds management. It has been promoted as an eco-friendly and sustainable solution to urban waste and aquatic weed management (Akanbi *et al*., 2007). It encourages the production of beneficial microorganisms, which in turn break down organic matter to create humus, which increases the nutrient content in soils and improved soil structure and water holding capacity. Compost has also been shown to suppress plant diseases and pests and enhance higher yields of agricultural crops. The process of composting is focused on breaking down or decomposing those parts of the water hyacinththat are most easy to decompose.

This includes sugars, starches, fats and proteins. A key advantage of the composting process is that its high temperature essentially kills all pathogens and weed seeds that might be found in wastes. Bacteria, fungi and actinomycetes are the microorganisms responsible for the composting process. During composting, microbial decomposition aerobically transforms organic substrates into a stable, humus-like material (Brown and Subler 2007). Cucumber (*Cucumis sativus*) is an important vegetable crop grown in the temperate and tropical zones of the world and it belongs to the guard family cucurbitaceae (Adams, 1992). It requires a stable warm temperature for good yield (Gobeil and Gosselin, 1990). With respect to economic importance, it ranks fourth after tomatoes, cabbage and onion in Asia (Eifediyi and Remison, 2011). Cucumber is one of the monoecious annual crops in the Cucurbitaceae family that has been cultivated by man for over 3, 000 years (Adetula and Denton, 2003). Cucumber is a good source of vitamins A, C, K, and B6, potassium, pantothenic acid, magnesium, phosphorus, copper and manganese. The ascorbic acid and caffeic acid contained in cucumber help to reduce skin irritation and swollen organs. The objective of the study therefore is to determine the effect of water hyacinth based compost on the yield and quality of cucumber (*Cucumis sativus*).

MATERIALS AND METHODS

Preparation of water hyacinth compost

Water hyacinth was harvested manually, sun-dried and chopped into small pieces of about 5 cm and above the ground, closed aerobic heap design was used to prepare the compost for maturity and apply the microbial culture at the rate of 10 g (solid formulation) per kg of chopped water hyacinth. While during composting, moisture (50%) and turning were maintained that leads to better aeration and enhancing the composting process. Different treatments

were separately composted for 8-10 weeks following the method of Akanbi *et al.* (2002). Matured composts were air dried and analysed for nutrient contents. The result was used to estimate the quantity of each compost required to supply needed nutrient to the test crop. The following treatments schedule were employed with three replication.

T_1- Water Hyacinth + *Cellulomonas* sp
T_2 - Water Hyacinth + *Trichoderma* sp
T_3- WaterHyacinth + *Penicillium* sp
T_4-Water Hyacinth + *Cellulomonas* sp+ *Trichoderma* sp
T_5- Water Hyacinth + *Trichoderma*sp+ *Penicillium*sp
T_6- Water Hyacinth + *cellulomonas*sp+*Penicillium*sp
T_7-Water Hyacinth + *Cellulomonas*sp+ *Penicillium* sp+ *Trichoderma* sp
T_8 - control (Water hyacinth alone)

Experiment Design and Treatments
Experimental field was ploughed and demarcated into three replicates each measured 7 m × 15.6 m (109.2 m2) with 1 m gaps between each plot. The experiments were laid out in a Randomized Complete Block Design with eight treatments and three replications. The crop was spaced 1 m × 0.5 m, this gives a plant population of 20,000 plants/ha. The nitrogen recommendation for the test crop (60 Kg N/ha) (Togun *et al*., 2003) was used as the basis for estimating the quantity of various fertilizer materials applied (Table I). At planting, three seeds were dropped per hole. At two weeks after sowing (WAS), thinning or supplying was done to obtain optimum plant population. The following treatments schedule were employed with three replication.

T1-2.5 t of water hyacinth compost
T2-2.5 t of water hyacinth compost +25 % of NPK
T3-2.5 t of water hyacinth compost +50 % of NPK
T4- 2.5 t of water hyacinth compost +75 % NPK
T5 -100 % NPK chemical fertilizer
T6- Control

RESULTS

Effect of microbial cultures on Water Hyacinth Compost preparation
The effect of microbial cultures on physio- chemical and nutrient content of water hyacinth compost are presented in table I. The physio chemical and nutrient content like PH, electrical conductivity (EC), carbon, nitrogen (N), phosphorous (P), potash (K), iron (Fe), manganese (Mn), zinc, copper of water hyacinth compost were analysed. The PH of the compost of all treatments recorded 7.0. Whereas EC showed higher values in uninoculated compost when compare to inoculated treatments. Among the different treatments, the treatment T_7 (water hyacinth composted with *Cellulomonas* sp, *Pencillium* sp *and Trichoderma* sp) showed highest percentage of decrease in carbon content and recorded the value of 24.02 percent reduction from the initial level. The treatment T_6 (water hyacinth composted with *Cellulomonas* sp and *Pencilllium* sp) and T_4 (water hyacinth composted with *Cellulomonas* sp)were recorded 26.56 and 27.10 percent reduction respectively.

The highest nitrogen, phosphorous and potash content of water hyacinth compost were obtained (2.15, 1.26 and 1.96 %) in treatment T_7(Water hyacinth composted with *Cellulomonas* sp + *Penicillium* sp + *Trichoderma* sp) and followed by the treatment T_6 (water hyacinth composted with *Cellulomonas* sp, *Penicillium* sp) and recorded per cent of 1.97, 1.23 and 1.23 respectively. The treatment T_6 and T_4 were on par with each other and significant over all other treatments. The microbial cultures inoculated treatment T_7 (water hyacinth compost with *Cellulomonas* sp. *Penicillium* sp. *and Trichoderma sp*) showed highest values in Fe, Mn, zinc and copper content and recorded the value of 193, 38, 64 and 19 ppm respectively and followed by the treatment T6 (water hyacinth composted with *Cellulomonas* sp + *Trichoderma*

sp) recorded 189,37,62 and 18 ppm respectively, whereas T1- control (uninoculated water hyacinth compost) recorded lowest content of Fe, Mn, zinc and copper (184,35,58 and 17 ppm).

Effect of Water Hyacinth Compost on various components in cucumber

Application of mineral fertilizer and water hyacinth compost had significant effects on the performance of cucumber ($P \leq 0.05$).The higher fruit yield of 30.12 t ha^{-1} was obtained in the treatment T_4 (2.5 t of water hyacinth compost + 75 % of NPK). The application of water hyacinth compost different graded levels of NPK fertilizers significantly increases fruit yield over control. The treatment $T_4$and T_3 was on par with each other and the treatment T_1 and T_2 was on par with each .The lowest fruit yield of 16.89 t ha^{-1} was recorded in the treatment T6 (control). The maximum number of fruits (18 per plant) and fruit weight (130.88 g per fruit) were recorded in the treatment T_4 (2.5 t of water hyacinth compost + 75 % of NPK).The lowest number of fruits was recorded in the treatment T6 (control).The 100 percent recommended dose of NPK fertilizer applied cucumber plant augmented 15 fruits per plant and 124 g per fruit, which indicates the application of water hyacinth compost significantly increases the number of fruit and fruit weight of cucumber.

DISCUSSION

Among the different treatments, the treatment T_7 (water hyacinth composted with *Cellulomonas* sp, *Pencillium* sp *and Trichoderma* sp) showed highest percentage of decrease in carbon content**.** The C: N ratio of a substrate material reflects the organic waste mineralization and stabilization during the process of composting. The loss of carbon as CO_2 through microbial respiration that leads to reduction of carbon content in compost (Eiland *et al*., 2001). The highest nitrogen, phosphorous and potash content of water hyacinth compost were obtained (2.15, 1.26 and 1.96 %) in treatment T_7 (Water hyacinth composted with *Cellulomonas* sp + *Penicillium* sp + *Trichoderma* sp).The grade of NPK will keep increasing until the end of process of making compost because the process of changing mineral NPK-organic becomes NPK-minerals by microorganism (Outerbridge, 1991). Water hyacinth compost application increased the growth attributes of cucumber such as number of fruits per plant, and fruit weight and yield at different stage. Maximum number of fruits per plant (19), fruit weight (130.66 g) and the fruit yield (30.12 t/ ha) were recorded in treatment T_4 (2.5 t of water hyacinth compost +75 % of NPK) followed by the treatment T_3 which recorded 128cm. whereas the control recorded only 7 fruits per plant. (Eifediyi and Remison 2010). Application of mineral fertilizer plus compost (2.5 t of water hyacinth compost +75 % of NPK) resulted in an increased in yield attributes (number of fruit per plot). The higher yields obtained from plots with treatments may be due to their higher nutritional content particularly Fe, Zn and Mn in compost (Akanbi *et al*., 2002). These elements encourages vegetative growth and total chlorophyll and the photosynthetic rate, which enhance flowering and fruiting leading to an increase in early fruit maturity (Ehaliotis *et al*., 2005).

CONCLUSION

The application of 2.5 t per ha water hyacinth compost prepared with microbial cultures along with 75% NPK fertilizers significantly enhanced the growth and yield of common cucumber.

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Table 1: Effect of microbial cultures on physio- chemical and nutrient content of water hyacinth compost

S. No	Characteristic	TREATMENTS							
		T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
1.	PH	7.0	7.0	7.0	7.0	7.0	7.0	7.1	7.0
2.	EC(dsm^{-1})	2.29	2.21	2.19	2.22	2.20	2.23	2.15	2.47
3.	N (%)	1.84	1.85	1.85	1.87	1.86	1.97	2.15	1.20
4.	P (%)	1.20	1.21	1.20	1.22	1.23	1.23	1.26	1.17
5.	K (%)	1.89	1.89	1.90	1.92	1.92	1.93	1.96	1.78
6.	Fe (ppm)	184.00	185.00	185.00	187.00	187.00	189.00	193.00	176.00
7.	Manganese(ppm)	35.00	35.00	35.00	36.00	37.00	37.00	38.00	32.00
8.	Zinc(ppm)	58.00	59.00	59.00	61.00	60.00	62.00	64.00	53.00
9.	Copper (ppm)	17.00	17.00	17.00	18.00	18.00	18.00	19.00	14.00
10.	Carbon (%)	28.99	29.00	28.01	27.10	27.25	26.56	24.02	39.69

Table II. Effect of water hyacinth compost on various yield components of cucumber

S. No.	Treatments	No. of fruits / plant	Fruit weight of cucumber (g)	Fruit yield of cucumber (t/ha)
1.	T1- 2.5 t of water hyacinth compost	12	118.21	24.99
2.	T2- 2.5 t of water hyacinth compost +25 % of NPK -	14	120.65	25.15
3.	T3 -2.5 t of water hyacinth compost +50 % of NPK	18	130.21	29.54
4.	T4- 2.5 t of water hyacinth compost +75 % of NPK	19	130.88	30.12
5.	T5 - 100 % NPK chemical fertilizer	15	124.00	27.11
6.	T6 - control	7	110.37	16.89
CD (p=0.05)		0.37	0.58	0.43
SEd.		0.15	0.24	0.18

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RESEARCH ARTICLE

Senttiment Analysis on Social Networks Users Data by using Naive Bayes Classifier

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ABSTRACT

Sentiment analysis of Twitter data. Sentiment or utilizes the naive Bayes Classifier to classify Tweets into positive, negative neutral, or negation We present experimental evaluation of our Live Review Twitter dataset and classification results, Sentiment Analysis is a task to identify a text as comments, reviews or message. Social Networks have changed the manner by which individuals convey. Data Accessible from informal organizations is useful for examination of client assessment, for instance estimating the criticism on an as of late delivered item, taking a gander at the reaction to strategy change or the pleasure in a continuous occasion. Physically filtering through this information is monotonous and possibly costly. Feeling examination is a moderately new region, which manages removing client assessment consequently. An illustration of a positive opinion is, "normal language handling is entertaining" then again, a negative feeling is "it's an awful day, I am not heading outside". Objective messages are considered not to communicate any opinion, for example, news features, for instance "organization racks wind area plans". There are numerous manners by which interpersonal organization information can be utilized to give a superior comprehension of client assessment such issues are at the core of natural Language processing (NLP) and information mining research. In this paper we present an instrument for opinion investigation which can examination Twitter information. We tell the best way to consequently

gather a corpus for feeling examination and assessment mining purposes. Utilizing the corpus, we assemble a feeling classifier that can decide good, pessimistic and objective opinions for an archive.

Keywords: Natural Language processing (NLP), Social Networks, Sentiment analysis, Naive Bayes Classifier. R- Programming, Support Vector Machine (SVM)

INTRODUCTION

R is an open-source programming language and programming environment for verifiable enrolling and plans that is maintained by the R Foundation for Statistical Computing. The R language is extensively involved among investigators and data diggers for making quantifiable programming and data examination. Studies, audits of data backhoes, and examinations of shrewd composing informational collections show that R's universality has extended impressively in continuous years. R is a GNU group. The source code for the R programming environment is created mainly in C, Fortran, and R. R is uninhibitedly open under the GNU General Public License, and pre-consolidated twofold structures are obliged different working systems. While R has a request line interface, there are a couple of graphical front-closes open .R is an execution of the S programming language got together with lexical examining semantics spurred by Scheme. S was developed by John Chambers while at Bell Labs. There are a couple of critical differences, yet an enormous piece of the code made for S runs unaltered. R was made by Ross Ihaka and Robert Gentleman at the University of Auckland, New Zealand, and is at present advanced by the R Development Core Team, of which Chambers is a section. R is named to some degree after the essential names of the underlying two R makers and not completely as a play on the name of S. The endeavor was viewed as in 1992, with a hidden variation conveyed in 1995 and a consistent beta structure in 2000.

Existing System

For the Review based sorting the Support Vector Machine is utilized since it gives the best exactness of opinions. It is a strategy for the order of both direct and nonlinear information. The SVM looks for the straight ideal isolating hyper plane (the direct portion), which is a choice limit that isolates information of one class from another. In the event that the information is straight indivisible, the SVM utilizes nonlinear planning to change the information into a higher aspect. It then, at that point, take care of the issue by seeing as a direct hyper plane.

Disadvantages

- Biased reviews.
- Subtlety.
- Thwarted Expectation.
- Ordering effects.
- Aspects or attributes finding.
- Difficult interpretation of resulting model.

Proposed System

In this, the Sentence level Categorizer is utilized for gathering the datasets from Twitter. The datasets are then tokenized by TOKENIZER. The tokens are then handled by DATA PRE-PROCESSING for example Information cleaning, Data Integrity, Data Transformation and Reduction is done to a justifiable arrangement this is then suggested to an identifier for recognizing whether the given information is positive, negative, nonpartisan, or refutation. Naïve Baye's Classifier is to order the datasets since it is the best classifier for Sentence Level Categorization. Tweets and messages are short: a sentence or a feature rather than an archive. The language utilized is extremely casual, with innovative spelling and accentuation, incorrect spellings, shoptalk, new words, URLs, and class explicit phrasing and truncations, for example, RT for "re-tweet" and # hash labels, which are a kind of labelling for Twitter messages. Another part of online media information, for example, Twitter messages is that it incorporates

rich organized data about the people associated with the correspondence. For instance, Twitter keeps up with data of who follows who patch re-tweets and labels within tweets give talk data. By the Naïve Bayes Classifier Algorithm, the arranged information's are pictured by R-stage.

Advantages of Proposed System

- Model is easy to interpret.
- Can be Domain-Specific.
- Can be more Robust.
- Efficient computation.

RELATED WORK

Fetching Data

First get the raw data from the twitter do to their examination utilizing R language. Stream R bundle permits clients to get twitter Data continuously by associating with Twitter Stream API.

TOKENIZING

In sentimental analysis, tokenization is the method involved with separating a flood of text into words, expressions, images, or other significant components called tokens. The rundown of tokens becomes input for additional handling, for example, parsing or text mining. Tokenization is valuable both in semantics (where it is a type of message division), and in software engineering, where it frames part of wistful investigation. A tokenizer gets a surge of characters, splits it up into individual tokens (generally individual words), and results a flood of tokens. The tokenizer is additionally liable for recording the request or position of each term (utilized for expression and word vicinity questions) and the beginning and end character counterbalances of the first word which the term addresses (utilized for featuring search pieces).

Data Pre-Processing

Data preprocessing is an information mining procedure that includes changing crude information into a reasonable organization. Genuine information is regularly deficient, conflicting, or potentially ailing in specific practices or drifts, and is probably going to contain numerous blunders. Data preprocessing plans crude information for additional handling.

sentence detection

In the wake of finishing the data preprocessing the information are changed to the reasonable arrangement. Which gives the right distinguishing proof and precise significance of the information. And furthermore, it lessens the sentence as revelatory, Imperative, Interrogative Sentence.

Classifying the Text

The data are ordering utilizing the naive bayes classifier. The innocent naive bayes classifier is utilized for AI cycle and it groups the information at specific way, for example, positive or negative information and so on naive bayes is an extremely straightforward arrangement calculation that makes a few in number presumptions about the freedom of each info variable.

Visualizing the Data

It produces the output of the classifying the data such as Positive, negative, neutral and negation are estimated from the twitter.

System Architecture

The above figure shows System Architecture

Naive Bayes Classifier

Naive Bayes classifiers are a group of basic probabilistic classifiers in light of applying Bayes' hypothesis with solid (gullible) freedom suppositions between the highlights. naive Bayes has been concentrated widely since the 1950s. It was brought under an alternate name into the text recovery local area in the mid1960s, and stays a well-known (gauge) strategy for text arrangement, the issue of making a decision about records as having a place with one classification or the other (like spam or genuine, sports or governmental issues, and so forth) with word frequencies as the elements. With proper pre-handling, it is serious in this space with further developed techniques including support vector machines. It additionally tracks down application in programmed clinical determination. Naive Bayes classifiers are exceptionally adaptable, requiring various boundaries direct in the quantity of factors (highlights/indicators) in a learning issue. Most extreme probability preparing should be possible by assessing a shut structure articulation, which takes straight time, rather than by costly iterative estimate as utilized for some different kinds of classifiers. In the insights and software engineering writing, Naive Bayes models are known under an assortment of names, including basic Bayes and autonomy Bayes. This multitude of names reference the utilization of Bayes' hypothesis in the classifier's choice rule, however naive Bayes isn't (really) a Bayesian strategy.

CONCLUSIONS

Evaluation examination or decision mining is a field of study that looks at people's speculations, mindsets, or sentiments towards explicit components. This paper handles a chief issue of end assessment, assessment furthest point grouping. Online thing reviews from Amazon.com are picked as data used for this examination. An assessment limit arrangement process has been proposed close by point-by-point portrayals of every movement. Tests for both sentence-level course of action and review level request have been performed.

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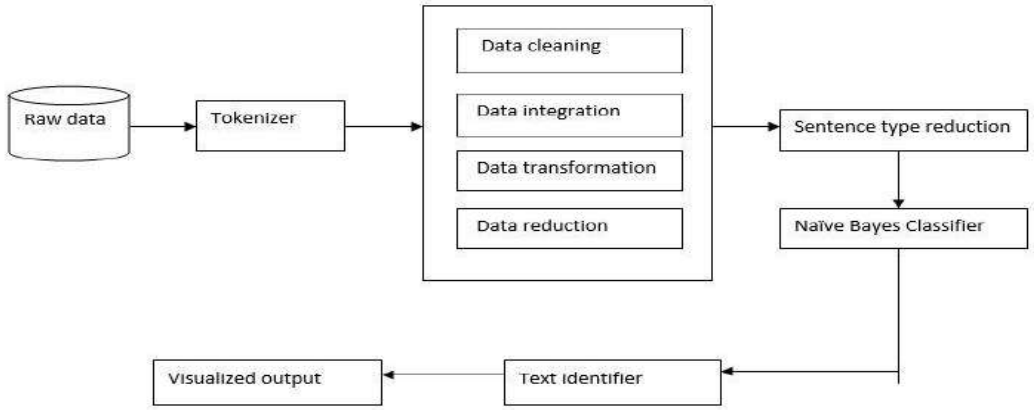

Fig. 1. The above figure shows System Architecture

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RESEARCH ARTICLE

Role of A Evolutionary Conserved Hypothalamic Neuropeptide: Neuropeptide Y (NPY) in Release of Gonadotropin and Anterior Pituitary Hormones in Different Animal Groups

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ABSTRACT

The neuroendocrine control of gonadotropin secretion is attained by the ensemble of Luteinizing Hormone Releasing Hormone (LHRH) secreting neurons that are distributed within the anterior hypothalamus. These neurons are the main element of hypothalamo-hypophysiotropic association and their activity in turn is modulated by neurotransmitter or peptidergic synaptic inputs. In recent years, considerable attention has been focused to evaluate the role of neuropeptides that have been identified in the Central Nervous System (CNS) especially in the hypothalamus. Some of the neuropeptides of the hypothalamus modulate the release of LHRH and which in turn regulates the LH release. One such peptide released from the hypothalamus is Neuropeptide- Y, that acts as both neurotransmitter and neurohormone with multiple diverse effects like stimulation of feeding, inhibition of sex behaviours and modulation of cardiovascular parameters .Its role has also been found in severe stress and pathogenesis of bulimia ,low renin hypertension and in Alzheimer's disease which further signifies the importance of its study. NPY shows high degree of conservation throughout evolution .The present review is on the effect of Neuropeptide- Y on the levels of GnRH with major effects on LHRH .

Keywords: neuropeptide , hypothalamus , NPY , neurons , LHRH , LH ,FSH ,GnRH.

INTRODUCTION

Neuropeptides are small sized disparate group of hypothalamic signaling molecules that plays a significant role in communication among the cells in the central nervous system (CNS) and also a crucial role in cell-to-cell

communication by influencing the gene expression (Landgraf and Neumann.,2004), synaptogenesis (Theodosis*et al*.,1986), modulation of membrane excitability (Merighi*et al*.,2011) where some of the neuropeptides even act as neurotransmitters (Hokfelt *et al*.,2004). The hypothalamus secretes a variety of neuropeptides with Neuropeptide Y (NPY) a 36 amino acid neuropeptide that is expressed all over the arcuate nucleus of the hypothalamus. It was first described as an abundant peptide in porcine brain by the method of detecting C-terminal amide .Later in 1985, amino acid sequence of porcine NPY was determined and succeeding to it was investigated that the amino acid sequence for species such as human, rat and guinea pig is identical `(Hare *et al*.,1988). Moreover, both the mRNA and the peptide sequence displayed a high degree of conservation throughout evolution (Cerda*et al*.,2000 ;Larhammar, D .,1996 and Minth*et al*.,1986) ,indicating its sustained functional relevance in species of human, rat, porcine and guinea pig (Thorsell*et al*.,2017). Since then a robust body of literature and research has been done to investigate the potential functions of this neuropeptide. Initially, the role of NPY was significantly analyzed in the regulation of feeding, body weight and blood pressure but the recent findings reveals more ingenious potential functioning of NPY in affective disorders, bone formation and cravings. (Gehlert*et al*.,2007).Till date five different subtypes of this peptide have been recognized i.e Y1,Y2,Y4,Y5 and Y6. Its mode of action has been till date studied in various species like porcine , rabbit, rat ,ewe , catfish, rhesus monkey, heifers and humans. The aim of the present study is to encapsulate how NPY affects the hormonal secretion of Hypothalamus and Anterior pituitary.

METHODS

This systematic review was carried out to study the role of neuropeptide Y in release of Gonadotropin and Anterior Pituitary hormones in different animal groups. The information was obtained through a comprehensive literature search using electronic databases of PubMed, Scopus, Research Gate from 1980 to 2021 from journal articles and the databases of the e-theses Online service and Dissertations. The combination of keywords used were as follows: [Neuropeptide Y, rats NPY, mode of action of NPY, latest findings on NPY, role of NPY in ewe, role of NPY in pigs, rabbit NPY , human NPY, effect of NPY on GnRH and LH].

Inclusion Criteria

Studies were included in this review if they were experimental (in vivo and in vitro) or clinical studies on the role and effect of NPY in different animals and if they were articles published in English.

Data Extraction and Handling

The following details were taken out from each selected study: 1) the role of NPY on gonadotropin and anterior pituitary gland secretions 2) method used, including animal species or cell lines, study design 3) outcomes 4) findings on NPY effects.

RESULTS

Mode of action of NPY on LHRH in Rats

A significant amount of research has been done till date on rats in different aspects to examine the role of NPY and how it effects the release of LHRH from the hypothalamus and LH from the pituitary .In rats, NPY is localized with LHRH secreting neurons in the hypothalamus (Allen *et al*.,1983 ; Chronwall*et al*.,1985) which reflects its probable role as a neuromodulator in mastering the LHRH release from hypothalamus (Tsuruo*et al*.,1990). Three modes by which NPY might influence LH release have been proposed. First, it may directly affect LHRH output independently. Second, it may be co-released with adrenergic (epinephrine-EP) transmitter to control LHRH secretion. Third, it might monitor and then release EP(epinephrine) (Crowley and Kalra,1988; Crowley *et al*.,1986 ;Kalra,S.P, 1983 ; Kalra*et al*.,1988 ; Minami *et al*.,1990 ; Sahu*et al*.,1990). McDonald *et al*.,(1985) assessed the effects of NPY on hypothalamic and pituitary function by injecting NPY into the third ventricle *in vivo* and by examining its action on perfused pituitary cells *in vitro*. Upon injecting NPY into the third ventricle in conscious ovariectomized rat an extreme depletion in the plasma level of Luteinizing hormone (LH) and moreover, a notable decrease in the plasma

levels of growth hormone wasdetected . Thus, it was concluded that NPY acting as a robust neurohormone hampers the secretion of LH in ovariectomized rats, with an activity period lasting for about 2 hours. Further, its effects on FSH was also noted and it was seen that NPY stimulated the production of FSH in the plasma. So, it was inferred from the study that on the one hand NPY inhibited the level of LH and growth hormone while on the other promoted the secretion of FSH (Follicle Stimulating Hormone). Kalra and Crowley(1992) also worked upon the method of action of NPY on LH secretion in male rats and were of the opinion that neuropeptide Y (NPY) serves as an principal neuromessenger in the control of anterior pituitary hormone secretion and also plays a critical role in stimulating the preovulatory surge of LH release in different species. The stimulatory effect of NPY on LH secretion is dependent upon the presence of gonadal hormones and this involves amplification of the response of other interacting stimulatory signals. They also hypothesized the mode of action of NPY and stated that it functions by exciting the release of LH-releasing hormone (LHRH) via a process that leads to the mobilization of intracellular Ca2+ and these stimulatory LHRH responses are mediated by Y1 NPY receptors. S Li *et al*.,(1994) through a series of experiment studied the role of neuropeptide Y in the control of Gonadotropin releasing hormone gene expression in the rat preoptic area and led to a conclusion that NPY positively regulates the genetic expression of GnRH in neurons via the Y_1 NPY receptor subtype. Furthermore , NPY also activates the postsynaptic messenger pathways that complement and fortify those affected by norepinephrine. Additionally, NPY is released into the hypophyseal portal blood for transportation to the anterior pituitary where it amplifies the release of LH in response to LHRH.

Indeed, this modulating effect at the pituitary level requires an allosteric increase in LHRH binding to its receptor leading to augmented influx of Ca2+ from the extracellular space. In case of aged male rats due to the incapacity of hypothalamic NPY neurons to respond to the trophic effects of androgens, the secretion of NPY declined. Further many more studied were done to study the role of neuropeptide Y and a such attempt was made by DamasiaBecú-Villalobos and Carlos Libertun(1995) who worked on development of gonadotropin releasing hormone (GnRH) neuron regulation in the female rat .They concluded that there is a concomitant extension in excitatory inputs, mainly noradrenaline, excitatory amino acids, and NPY, which increase the synthesis and release of GnRH at the beginning of the juvenile period and participate in the coupling of GnRH neural activity to the ongoing rhythmic activity of a hypothalamic circadian oscillator. Leupen*et al*.,(1997).,demonstrated in male rats that activation of neuropeptide Y receptors of the Y1 subtype is required for the physiological amplification of the spontaneous preovulatory LH surge. They also concluded that NPY strongly facilitates the action of LHRH and in case LHRH is absent it does not show any effect on the LH release and it works by intensifying the LH releasing activity of LHRH. Misra*et al*.,(1999) evaluated the role of Neuropeptide Y (NPY) and Epinephrine (EP) in the regulation of luteinizing hormone (LH) release in male rats. Intraventricular (III v) injection of NPY, EP or NPY+EP were given to immature (23-30 days) and adult (80-100 days) male rats and plasma was collected at different intervals upto in adults it caused a rise in LH levels. This indicated that the LHRH neuronal system remains insensitive to NPY before the onset of puberty. A stimulatory role of EP on plasma LH was observed in all age groups .

It was concluded by results that NPY or EP alone failed to enhance LH release from AP cells (anterior pituitary) cells obtained from both age groups whereas, when given along with LHRH , only NPY resulted in dose related potentiation of LH response from adults AP cells. Thus, results indicated that NPY might have dual site of possibly acts only at the level of hypothalamus to modulate LH release. Xu*et al*.,(2000) further investigated to render the part of neuropeptide Y in regulation of the reproductive axis in knockout mice where reproductive hormonal secretion would be imperiled in the absenteeism of NPY. Hormonal secretions were examined in both NPY-knockout (NPY-KO) mice and wild type (WT) under conditions of basal release followed by ovariectomy in proesterus mice post estrogen treatments. After the studies it was revealed that the study undertaken did not support the idea of NPY playing a crucial role in the regulation of basal gonadotropin secretion or in mediating negative feedback actions of gonadal hormones. Moreover, the study demonstrated that preovulatory NPY release is required for normal amplification of the LH surge that occurs on proestrus .Further Involvement of NPY in the generation of normal LH surges is partially moderated by the capacity of the peptide to prime the anterior pituitary gland to GnRHinvigoration . Saxena and Misra (2000) observed that in immature rats, NPY failed to cause any variation in plasma LH while in both peripubertal and adult rats, only the higher doses of NPY significantly .

Sabatino *et al*.,(2008) conducted a series of experiment to explore the conjecture that in vitro administration of progesterone to estrogen-treated ovariectomized (OVX) rats enhances the stimulatory effects of neuropeptide Y (NPY) on the secretion of luteinizing hormone-releasing hormone (LHRH).But ,upon experimentation it was observed that the results do not support this hypothesis. On the contrary, when plasma estrogen levels are alike to those on of proestrus, treatment with physiological doses of progesterone slightly attenuates the effects of NPY. Injection of a pharmacological dose of progesterone significantly decreases NPY-stimulated LHRH release in spite of significantly elevated levels of LHRH in the ME (Median eminence) .Moreover, the administration of physiological doses of progesterone had no effect on NPY-stimulated LHRH release at stunted physiological levels of estrogen replacement. The representation of the research on NPY in rats is tabulated in table 1.
+ shows increase in the level of secretion
-Shows decrease

Endocrine actions of central neuropeptide Y on LHRH/LH secretion in Ewe

The effect of Neuropeptide Y was also studied in female sheep. Malven *et al*.,(1992) evaluated the role of intracerebral administration of NPY on LH in ovariectomized sheep and concluded that action of NPY inhibits the Luteinizing hormone-releasing hormone (LHRH). Further, Ducan*et al*.,(1993) studied the endocrine actions of central neuropeptide Y in Ewe and investigated that whether central administration of NPY can alter the activities of the reproductive and hypothalamo-pituitary-adrenal axes, whether the ovarian steroids are involved in the modulation of these events. An attempt was also made to investigate whether endogenous NPY plays an important role in the control of luteinizing hormone-releasing hormone/luteinizing hormone (LHRH/LH) secretion in the sheep oestrous cycle. After their studies they concluded that tonic LHRH/LH secretion remains uninfluenced by centrally admistered NPY doses. However, a clear support to the findings that NPY is involved in the multielimental regulation of adrenocorticotrophin and cortisol secretion in this species was seen when the same dose of NPY activated the hypothalamo-pituitary-adrenal axis, probably by stimulating corticotrophin-releasing hormone and/or arginine vasopressin secretion within the hypothalamus. Further the immunization experiments proposed that hypothalamic NPY might also play a part in the modulation of the tinning of the LHRH/LH surge in the ewe. In contrast to the role of NPY in this regard in the rat, this only occurs at the level of the hypothalamus. Gładysz*et al*.,(2003) examined the effect of NPY on the GnRH/LH secretory activity in early anoestrous ewes by crossbreeding the ewes after the last oestrous cycle in one week (group 1w, n=7) and six week (group 6w, n=7) and grouped them into different groups. They were then infused with Ringer solution (control) or 50 μg of NPY to the third ventricle for 5 min .Blood infusions were taken for Radioimmunoassay and studies showed that the ancestral groups contradicted only in the optical densities of irGnRH and ir LH, which were lower in group 6w compared to group 1w ($p<0.001$).Indeed, the LH secretion level was found to be similar in both the ancestral groups. So,as an outcome of the study it was suggested that NPY may be involved in the central regulation of reproductive function in ewes, however, the sensitivity of the GnRH/LH axis to NPY modulation declines throughout the early anoestrous period.

Modulation of LH and GnRH in Pigs by Neuropeptide Y

A study was done by Siawrys and Buchowski (2018) in early pregnant pigs to inspect that whether NPY directly affects basal and gonadotropin releasing hormone (GnRH) induced luteinizing hormone (LH) secretion and intracellular accumulation by AP cells and also whether NPY and its receptor (Y1 and Y2) mRNAs are expressed in the AP gland in pregnant pigs (days 14 – 16). Additionally, the expression of genes encoding b subunit of luteinizing hormone (b-LH) and GnRH receptor (GnRH-R) was determined in porcine AP gland. The anterior pituitary was dislodged using trypsin and the acquired pituitary cells were pre-incubated and then treated with the doses of GnRH and NPY alone and in combination both. The cellular contents were then observed using radioimmunoassay. Upon successful investigation it was stated that NPY had no effect on basal LH secretion or basal and GnRH-induced LH accumulation in AP cells, whereas its maximum dose only displayed a propensity to inhibit GnRH induced release of LH from the cells of Anterior Pituitary. The role of Y2 receptors was laid forward in the modulation of LH secretion by AP cells in pregnant pigs.

Endocrine control by NPY in Rabbit

Khorram*et al*.,(1987) postulated that NPY has Bimodal effects on hypothalamic release of gonadotropin-releasing hormone in conscious rabbits. He stated that intra hypothalamic injecting NPY showed different outcomes in ovary intact and ovariectomized rabbit. The level of GnRH gets stimulated in intact rabbit whereas the levels of GnRH and LH decreased significantly. Indeed, the plasma levels of FSH and prolactin remained unaffected in both intact and ovariectomized rabbits. Thus, Bimodial effects were seen of NPY in different cases. In rabbit's ovary NPY had arousing effects on both the secretion levels of LH and GnRH. Kaynard and Spines (1991) performed a study in which they computed the pattern of basal LH release in the rabbit after passive immunoneutralization of endogenous NPY. For the study eight rabbits were taken and firstly and third cerebroventricularcannulae and venous catheters were subjected to 8 h of blood sampling at 15-min intervals. Intracerebroventricular (icv) insertion of 1 ml of either normal rabbit serum (NRS) or NPY antiserum (NPY-Ab; raised in rabbits against human NPY) was done succeeding the second hour of basal blood sampling and lasted for the left out 6 h of the 8-h protocol. It was then seen that after administering NPY-Ab the plasma level of LH was significantly hampered and suppressed after a time period of 165 minutes. Moreover, after a time period of 4 hrs the level of LH critically decreased by 42% as compared to the control. Treatment with normal rabbit serum had no impact on LH. To determine whether the same results would come in ovariectomized rabbit, the same protocol was repeated in four rabbits after two weeks of ovariectomy ,and it was then observed that the plasma levels decreased within 75 mins after administration. FSH secretion was not affected by NRS or NPY-Ab treatment in either intact or OVX does. These results clearly indicate that in both intact and OVX does, endogenous NPY is in part responsible for maintaining basal, tonic LH secretion.

NPY mode of action in Rhesus monkey

A series of investigation was also carried out on NPY mode of stimulation in rhesus monkey and as such study was done by Pau *et al*.,(1995) in which the site of injecting the NPY had different functioning. According to the observations it was concluded that unlike other mammalian species, in the rhesus monkey the stimulatory and inhibitory effects of NPY on GnRH release depend on the site of NPY infusion within the brain rather than the ovarian steroidal environment. Intracerebroventricular (icv) administration or direct infusion of NPY into the median eminence (ime) suppresses GnRH release in ovariectomized (OVX) animals, but stimulates GnRH release in intact or OVX animals. Mizuno *et al*.,(2000) postulated that progesterone induces a LHRH surge in estrogen-primed ovariectomized rhesus monkeys, with a concomitant increase in the pulse frequency of neuropeptide Y (NPY) release. Then ,Shahab*et al*.,(2003) through a series of experiment concluded that central nervous system receptors are involved in mediating the inhibitory action of neuropeptide Y on Luteinizing Hormone Secretion in the Male Rhesus Monkey (*Macaca mulatta*).

Significance of NPY in the regulation of GnRH-LH axis in Cat fish

As Neuropeptide Y remains evolutionary conserved in many species , its mode of action was evaluated by Subhedar et al.,(2005) .Consequence of NPY in the management of GnRH-LH axis was determined . Considerable NPY immunoreactivity was seen in the components like olfactory system, basal telencephalon, preoptic and tuberal areas, and the pituitary gland that deliver as neuroanatomical substrates for processing reproductive information. High Pressure Liquid Chromatography analysis showed that GnRH traces in the olfactory organ, bulb, preoptic area, telencephalon and pituitary increased significantly following NPY treatment. NPY may play a role in positive regulation of GnRH throughout the neuraxis and also up-regulate the LH cells in the pituitary.

Study on NPY in Humans

The studies on NPY has been studied since long on different species . Its effect was also seen in humans by a group of scientist. In 1991,Ding and his colleagues for the first time showed the presence of Neuropeptide Y (NPY) in liver , pancreas and gall bladder of human beings by Light and electron microscopy. Further, Watanobe*et al*.,(1994) investigated the effect of NPY on the secretions from anterior pituitary in human men . Intravenous bolus injection of 100 micrograms of human NPY alone did not affect the secretion of any anterior pituitary hormone or cortisol. However, when NPY (100 micrograms) was administered simultaneously with LH-releasing hormone (LHRH, 100 micrograms), a significant potential increase was observed in LHRH-induced LH secretion. Similarly, follicle-

stimulating hormone (FSH) response to LHRH was also slightly potentiated by the coadministration of NPY, although this effect was not statistically significant. Recently in 2003, a study by Korner*et al.*,(2004) showed expression of NPY receptors in human primary ovary neoplasm and also in breast cancer. They stated that the high incidence and density of NPY receptors in sex cord-stromal tumors suggest that these receptors represent a new potential target for the diagnostic and therapeutic administration of NPY analogs in tumors.

CONCLUSION

This review highlighted the role of NPY in different animal models, its influence in different species like rats, rabbit, catfish , rhesus monkey , pigs and humans groups. Since its discovery and isolation from porcine brain extracts, NPY has gained significant attention for its functioning. Exciting new lines of research in humans has shown its expression in primary ovary neoplasm and also in breast cancer. Extensive analysis identifies its significant role in mastering the secretions of gonadotropin and Anterior pituitary i.e Growth hormone, Luteinizing hormone, Prolactin and Follicle stimulating hormone. The existing knowledge on Neuropeptide Y role in certain species is fragmentary and inadequate. The aim of the present review study of this neuropeptide was to emphasize on the fact that though much research on functioning of NPY has been done till date but still the explanation to the fact that in intact animal NPY stimulates the gonadotropin and anterior pituitary hormone but suppresses them in case of ovariectomized animals remains not much well known .Moreover, the biochemistry involved in differences in the site dependent effects of neuropeptide Y is still not yet very well clearly understood. The present review study shows the important role of this neuropeptide and emphaise that more research needs to be done on this novel neuropeptide as it has wide range of stimulatory role in hormonal control. The authors urges for more research on this aspect as this will be of considerable importance for further research on Neuropeptide Y.

CONFLICT OF INTEREST

The authors declare that there are no conflict of interest.

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Table 1.Role of NPY (Neuropeptide Y) in Rat GnRH and LH secretion.

Animal	Technique	Pharmacological Action	References
Ovariectomized rat	third ventricle	- LH	McDonald *et al.*,(1985)
Intraventricular	- Growth hormone		
		+ FSH	
Male rat	NA	+ LH	Kalra and Crowley(1992)
Immortalized	Cell culture	+ LH	Besecke *et al.*,(1994)
	Rat cell lines perfusion		
Castrated male rat	left lateral ventricle	+ GnRH	S Li *et al.*,(1994)
+ LH			
Female	NA	+ GnRH	Damasia Becú-Villalobos and Carlos Libertun (1995)
Male rat	NA	+ LH	Leupen *et al.*,(1997)

Table 2. Role of NPY (Neuropeptide Y) in Ewe GnRH and LH secretion

Animal	Technique	Pharmacological Action	References
Female sheep	intracerebral	LH level declines	Malven *et al.*,(1992)
Anoestrous sheep	third ventricle	LH level declines	Gladysz *et al.*,(2003)

Table 3. Role of NPY(Neuropeptide Y) in Rabbit GnRH and LH secretion.

Animal	Technique	Pharmacological Action	References
Intact rabbit	Intrahypothalamic Perfusion	GnRH stimulated LH stimulated FSH unaffected Prolactin unaffected	Khorram *et al.*,(1987)
Ovariectomized rabbit	Intra hypothalamic perfusion	GnRH decreased LH decreased FSH unaffected Prolactin unaffected	Khorram *et al.*,(1987)
Intact Rabbit	cerebroventricular cannulae of NPY-Ab to control	*suppressed LH in 165 mins *42% decreased as compared	Kaynard and Spines (1991)
Ovariectomized Rabbit	cerebro ventricular cannulae of NPY-Ab to control	*suppressed LH in 75 mins *42% decreased as compared	Karynard and Spines (1991)

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RESEARCH ARTICLE

Formulation and Evaluation of Colon Specific Pulsatile Drug Delivery System of Lamivudine

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ABSTRACT

Pulsatile drug delivery systems (PDDS) provide many advantages over conventional dosage forms. They provide the drug at the right time, place, and dose, providing greater benefit than standard dosages and increasing patient compliance. The drug is released fast and completely as a pulse after a lag time. These products have a sigmoid release profile. These systems help medications with chronopharmacological behaviour, requiring nocturnal dosage, and pharmaceuticals with a first-pass impact. Lamivudine is in a class of medications called nucleoside reverse transcriptase inhibitors (NRTIs). This drug may help to prevent the growth and spread of the cancer cells to other parts of the body. In earlier study, it was discovered that this particular type of colon cancer, which has a p53 mutation may be sensitive to treatment with lamivudine by impairing the ability of the cancer cells to grow. The colon specific pulsatile drug delivery system for the drug Lamivudine was prepared and evaluated for various parameters. The formulated tablet shows the lag time of 5 h with 5 % drug release and 99 % in 24 h, which proved the colon-specific pulsatile delivery for the drug Lamivudine.

Keywords: Pulsatile drug delivery, Colon-Specific, Lamivudine, Release pattern

INTRODUCTION

Drug-release profiles in these models often only consider the chemical and physical characteristics of pharmaceutical excipients [1,3].For increased therapeutic benefits, complex medication controlled-release profiles (such as multiple active components in a single dosage form, several phases in a single dosage form, simultaneous control of time and initial place, or particular control of site and release rate) are offered in new combined models. New combined models are frequently developed that integrate elements are developed[4,6]. There is now accessible a new and

advanced model for the controlled release of drugs, and one of these is pulsatile drug delivery that is colon-specific (also called colon-targeted). After a certain amount of time has passed, this model can facilitate the time- and site-specific release of pharmaceuticals in the colon, and it is one method for the administration of drugs. It is helpful in the treatment of a variety of common conditions, including angina pectoris, bronchial asthma, allergic rhinitis, hypertension, rheumatoid arthritis, and colorectal cancer, to name just a few [7]. Lamivudine is in a class of medications called nucleoside reverse transcriptase inhibitors (NRTIs). It works by decreasing the amount of HIV and hepatitis B in the blood. The FDA (the U.S. Food and Drug Administration) has not approved lamivudine for this specific disease but it has been approved for other uses.In this research study, the investigators are studying the colon-specific pulsatile drug delivery system of lamivudine, which may helpful for the colon cancer. This drug may help to prevent the growth and spread of the cancer cells to other parts of the body. In earlier study, it was discovered that this particular type of colon cancer, which has a p53 mutation may be sensitive to treatment with lamivudine by impairing the ability of the cancer cells to grow[8]..For this colon cancer the phase II & Phase III clinical studies were completed for the Lamivudine. So, in this present work an attempt was made to study the formulation and evaluation of colon-specific pulsatile drug delivery system of Lamivudine.

MATERIALS AND METHODS

Materials

Lamivudine was obtained from Emcure Pharmaceuticals, Pune, in the form of a complimentary sample. Both PVP and Sodium hydroxide were purchased from Thomas Baker (Chemicals) Pvt Ltd in Mumbai. Potassium dihydrogen phosphate (KH_2PO_4) of an HPLC-grade, acetonitrile of a purity of at least 99.80 %, methanol and triple-distilled water, and o-phosphoric acid were utilized in the experiment in the exact quantities that were provided by Merck India Ltd. (Mumbai, India). LobaChemie Pvt Ltd in Mumbai was the vendor for the purchase of HPMC E5. Research-Lab Fine Chem Industries in Mumbai provided PVP, Methanol, Chloroform, and Dibutyl Phthalate and DMSO. Rohm Pharma in Germany supplied us with Eudragit L100. All of the other reagents were obtained from Shaimil Laboratories Ltd. in Baroda, India, and they were all of the analytical grade. (99.69–99.99 % quality).

Methods

Preparation of Lamivudine core tablets

For the purposes of this investigation, the core tablets were manufactured using the method of direct compression and included 100mg of Lamivudine as their active component. The drug and all of the excipients, with the exception of the glidant and the lubricant, were blended together in a poly bag between five and ten min. The resulting mixture was next lubricated with the addition of glidant and lubricant, and finally, using 6 mm round flat punches, it was compressed into tablets with a total weight of 120 mg.

Preparation of Lamivudine double-compression coated tablets

Using a process known as double-compression coating, the manufactured core tablets were further coated with a variety of polymers (compositions shown in Table 2). After having the core tablets treated with an inner compression coat using sodium starch glycolate as the swelling layer, sodium alginate/HPMC K15M/Eudragit L100 as a release regulating outside compression coat. Each layer was adjusted to a weight of 90 mg, and the inner layer was compressed using 8 mm circular flat punches while the outer layer was compressed using 10 mm circular flat punches. This was accomplished by first placing half of the coating material in the die cavity, then carefully positioning cores in the middle, and finally placing the remaining half of the coating material.

Evaluation of compression coated tablets

Following the satisfactory completion of the compression coating process, the tablets that had been manufactured were examined for a range of physical characteristics, including variations in weight, hardness, friability, and drug content uniformity. In order to examine the weight variation, twenty tablets of each formulation were chosen at random and measured on an electronic weighing balance (AW 120, Shimadzu Corporation, Japan). The average

weights of these tablets were then determined. The hardness and friability of the produced tablets were then assessed so that the mechanical strength and integrity of the tablets could be evaluated. The Monsanto hardness tester was utilised in order to ascertain the level of tablet hardness, while the Roche friabulator was utilised in order to ascertain the level of tablet friability (Electro lab, Mumbai, India). The drug content uniformity of each formulation was evaluated by first crushing ten tablets that had been chosen at random. Then, an aliquot of the powder that was equivalent to 50 mg of drug was dissolved in an adequate quantity of pH 6.8 phosphate buffer solution. This was done in order to determine whether or not the drug content was consistent across all formulations. After the solution was filtered and diluted, the Lamivudine concentration was measured using a UV spectrophotometric technique at a wavelength of 270 nm.

In-vitro drug release study

In-vitro drug release tests with a sample size of three were conducted utilising a USP type II dissolving apparatus at 50 revolutions per minute and a temperature of 37^{o} C ± 0.5^{o} C in 900 millilitres of dissolution medium (0.1 N HCl for first 2 h; 3-4 h in 5.5 pH buffer and then in phosphate buffer pH 6.8 from 5 to 24 h). At regular intervals, a sample size of five millilitres (ml) was taken out of the dissolution medium and replaced with an equal volume of freshly prewarmed dissolution medium. After being withdrawn from further consideration, the samples were subsequently filtered and spectrophotometrically examined at 270 nm for Lamivudine. Then, the dissolution data was also used to calculate the mean dissolution time[9], T10 % and T80 % (time in hours to take 10 % and 80 % drug release, respectively), to explain the drug release from compression-coated tablets. MDT is the sum of different release fraction periods during dissolution studies divided by the initial loading dose [10].

Drug release kinetics

To determine the release kinetics, the data that was gathered from the in-vitro release of the drug was plotted using a number of different kinetic models. These models included the zero-order model, which plotted the cumulative amount of drug released against time, the first-order model, which plotted the log cumulative percentage of drug remaining against time, and the Higuchi model, which plotted the cumulative percentage of drug released against the square root of time [11,13].

Mechanism of drug release

When calculating the mechanism of drug release of the constructed PDDS, the Korsmeyer equation (log cumulative percentage of drug released versus log time) was utilised, and the exponent n was determined by determining the slope of the straight line [14].

RESULTS AND DISCUSSION

Evaluation of Lamivudine core and double-compression coated tablets

After conducting an analysis on the core tablets, it was established that all of the physically determined parameters were in accordance with the pharmacopeial limits. In a period of 15 min, the cumulative percent of drug release from the core tablet was found to be 99.73 %. All of the physical parameters that were measured for double-compression coated tablets were displayed in Table 3. During the weight variation test, the pharmacopeial limits for the tablets were determined to be between 295.5±3.42 and 306.12±4.26 mg. This represents not more than 10% of the tablets' average weight. It was discovered that tablets have a hardness of around 6 kg/cm^{2} and a friability of less than 0.5 percent, which demonstrates the consistency and durability of the tablets. The results of the assay on the produced tablets showed that they contained 98.61±0.34 to 101.12±0.98.

In vitro drug release studies

Based on the findings of the dissolution studies of sodium alginate formulations (LF1-LF3), HPMC K15M formulations (LF4-LF6), and Eudragit L100 formulations (LF7-LF9), the LF5 formulation showed a drug release of 5 % upto5 hours, and this drug release expanded continuously to 100.76% upto24 h. The formulations of sodium

alginate showed some compressibility problems and were also less efficient as a sustained release polymer, but the formulations of HPMC K15M and Eudragit L100 demonstrated good control in drug release together with suitable compressibility. On display in Fig. 1 is the drug release pattern resulting from core tablet and LF5 formulations. The MDT values for all of the different formulations ranged from 3.16 to 12.94. The T10 % value of the best formulation, LF5, was determined to be 5.5 h, while the T80 % value was found to be 19.8 h (Fig. 1).

CONCLUSION

In this present study, an attempt was made to study colon specific-pulsatile drug delivery system, with the drug Lamivudine. The core tablet and the double compressed tablets were formulated with various polymers and different concentrations. The core tablet released within 15 min and the doble compressed tablets were released for 24 h. The tablets were evaluated for various parameters and it passes all the test. From all the nine formulations, formulation LF5 was selected as the best formulation as it showed the good controlled release for a period of 24 h with the initial lag time of 5 h. The study was concluded that the colon specific pulsatile drug delivery system for the studied drug Lamivudine suggest that the formulation could be used to enhance the release profile of the drug Lamivudine positively.

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Table 1: Composition and characterization of Lamivudine core tablets.

Ingredients	Quantity (mg)
Lamivudine	100
Avicel	12.4
Crosspovidone	4
Talc	2.4
Magnesium stearate	1.2

Table 2 Composition of Lamivudine double-compression coated tablets

Formulation code	Core tablet (mg)	Inner compression coat (90 mg)* Sodium starch glycolate	Outer compression coat (90 mg)*			Total Tablet weight (mg)
			Sodium Alginate (mg	HPMC K15M (mg)	Eudragit L100	
LF1	120	30	15	-	-	300
LF2	120	30	30	-	-	300
LF3	120	30	45	-	-	300
LF4	120	30	-	15	-	300
LF5	120	30	-	30	-	300
LF6	120	30	-	45	-	300
LF7	120	30	-	-	15	300
LF8	120	30	-	-	30	300
LF9	120	30	-	-	45	300

*Each compression coat formulation contains 1% Magnesium stearate, 2% Talc and Avicel PH 102 to make up the compression coat weight.

Table 3. Physicochemical Parameters of formulated tablets

Formulation code	Average weight(mg)[n=20]	Thickness(mm) [n=3]	Hardness Kg/cm^2[n=3]	Friability (%)	Content (%)
LF1	300±3.59	3.90±0.01	6.128±0.02	0.1836±0.089	97.76±2.33
LF2	300.3±4	3.90±0.02	6.143±0.02	0.1333±0.034	99.93±2.05
LF3	300.2±4.05	3.94±0.02	6.157±0.022	0.1397±0.091	99.68±2.91
LF4	299.3±4.3	3.94±0.01	6.259±0.022	0.2737±0.105	100.78±2.18
LF5	299.5±3.98	3.96±0.02	6.266±0.024	0.2678±0.078	100.84±2.83
LF6	300.8±3.85	4.00±0.01	6.249±0.029	0.2202±0.097	100.64±1.09
LF7	299.7±4.14	3.94±0.01	6.269±0.022	0.2124±0.088	103.37±2.66
LF8	300.3±3.59	3.94±0.02	6.276±0.024	0.1816±0.132	101.79±1.46
LF9	300.5±3.69	3.98±0.01	6.279±0.029	0.1907±0.115	105.32±1.41

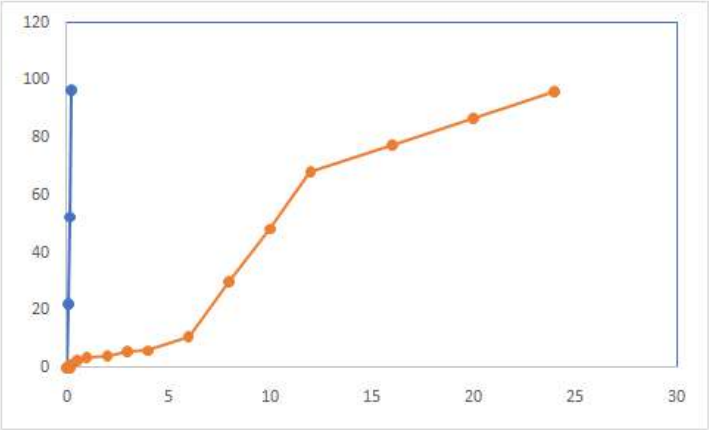

Fig. 1. Release Profile of Core tablet and double compressed tablets of Lamivudine

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RESEARCH ARTICLE

Effect of Humic Acid, Micronutrients and Growth Regulators on the Growth and Quality Parameters of Bhendi

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ABSTRACT

A field experiment was conducted to study the effect of humic acid, micronutrients and growth regulators on bhendi during July 2020 - October 2020 at Guddampatti village near Errabaiyahalli taluk, Dharmapuri district, Tamil Nadu. The experimental design adopted in the study was randomized block design with the following nine treatments, viz., T1 – Control (recommended dose of NPK) (80:40:40),T2- Humic acid @ 30 kg soil application,T3- Humic acid + Micronutrients mixture (Cu, Zn, Mn, Fe, Mo, B) @ 50 ppm,T4- Humic acid + Growth regulator1 (Gibberellic acid @ 50 ppm)T5- Humic acid + Growth regulator2 (Indole-3 Butyric acid @ 50 ppm),T6- Humic acid + Growth regulator3 (Naphthalene acetic acid @ 50 ppm),T7- Humic acid + Micronutrients mixture @ 50 ppm + Growth regulator1 (Gibberellic acid @ 50 ppm),T8- Humic acid + Micronutrients mixture @ 50 ppm+ Growth regulator2 (Indole-3 Butyric acid @ 50 ppm) ,T9- Humic acid + Micronutrients mixture @ 50 ppm+ Growth regulator3 (Naphthalene acetic acid @ 50 ppm) Each treatment was replicated thrice. The recommended NPK dose of 80:40:40 kg ha-1 was supplied through urea, single super phosphate and muriate of potash, respectively. The growth, yield and quality parameters of bhendi were recorded. Plant samples were collected at harvest stage, processed and then analyzed for their N, P, K, Ca, Mg, S, Cu, Zn, Mn and Fe uptake. The results of the field experiment revealed that combined application of HA @ 30 kg ha-1 + micronutrients mixture @ 50 ppm + growth regulators1(Gibberellic acid @ 50ppm) (T7) was recorded highest growth parameters viz., plant height (138.8 cm), number of leaves plant-1 (33.9), number of branches plant-1 (3.16),leaf area index (6.71), day taken to first flowering (40.55 days), Chlorophyll content (3.51 mg g-1) and dry matter production (16.13 t ha-1), and quality parameters viz., Titrable acidity in fruit sample (0.73 percent),

Ascorbic acid content in fruit sample (14.73 mg 100 g -1) crude fibre content in fruit sample (14.56 percent), crude protein content in fruit sample (13.42 percent) and Total soluble solids of fruit sample (5.05 percent), shelf life of fruits (8.76 days) and tenderness of fruits (7.53 days), Nutrient uptake (N, P, K, Zn, Cu, Mn and Fe) significantly increased with the application of HA @ 30 kg ha-1 + Micronutrients mixture @ 50 ppm + Growth regulators1 (Gibberellic acid @ 50 ppm) (T7). Present study concluded that combined application of humic acid @ 30 kg ha-1 along with micronutrients @ 50 ppm and growth regulators1 (Gibberellic acid @ 50 ppm) increased growth and quality characters of bhendi.

Keywords: Humic acid, Gibberellic acid, Indole-3 Butyric acid, Naphthalene acetic acid

INTRODUCTION

Okra (*Abelmoshus esculentus* L.*)* belongs to the family malveceae family. It is otherwise known as a queen of vegetables. In okra production they confined the revolution of Prabhani. It is an imperative vegetable crop in the tropical and subtropical area. It is suitable for both kitchens gardening as well as on large scale for commercial purpose (Naheed *et al.* (2013). The vegetable like palatable and liked equally by poor and rich man. Okra is a good sources of carbohydrate, protein, fats, vitamins and minerals (Arapitsas, 2008). It contains vitamins A, B, C and a source of calcium, iron, and niacin (Oliveira *et al.*,2014), and has a high nutritional as its fruit contain protein, 16.17%, 2.07% fat,60.90% carbohydrates, 326.93 energy, and contains an important elements such as zinc 51ppm, iron 371ppm, and calcium 107ppm (Hussain *et al.,* 2010). In India it is widely grown as spring summer and rainy season crop in states like Bihar, West Bengal, Odisha, Gujarat, Jharkhand, Andhra Pradesh, Madhya Pradesh, Chhattisgarh, Haryana and Assam. India produces about 60.96 lakh tonnes of okra from 5.09 lakh ha area with the productivity of 11.9 t ha-1. Humic acid is the one of the most important component of bio-liquid complex. Because of its molecular structure, it provide numerous to crop production. Humic acid may play a major role in the plant growth under different soil condition. The application of humic acid enhanced nutrient uptake, plant development, yield and quality in a number of plant species (Halime *et al.*2011). Addition of organic matter can improve the soil nutritional status as well as soil texture and its water holding capacity. Plant growth regulators (PGR's) are organic compounds, which in small amounts modify physiological process of plants. The used compounds of similar nature, produced by plants, are designated as plant hormones or phytohormones. Thus, plant growth regulators include artificially produced substances as well as phytohormones. The role of plant growth regulators including both growth promoters and retardants, in crop production is a well known phenomenon. Micro nutrients are required for optimal growth specifically six micronutrients (Zn, B, Fe, Cu, Mo, Mn) play vital roles in plant physiology and biochemical processes. (Putra *et al.* 2012). Foliar spray of micronutrients is more effective to control deficiency problem than soil application. Foliar Application of these nutrients is generally done to eliminate the effects of soil pH on the availability of these nutrients and for less costly. The aim of this study was to improve growth and yield characters of okra by foliar feeding of the micronutrients mixture. Hence the present investigation was carried out to study the effect of humic acid, micronutrients and growth regulators on bhendi with the following objectives. 1. To study the effect of HA, micronutrients and growth regulators on growth, yield and quality parameters of bhendi. 2. To study the effect of HA, micronutrients and growth regulators on uptake of macro and micronutrients by bhendi. 3. To study the effect of HA, micronutrients and growth regulators on available nutrients status of post harvest soil.

MATERIALS AND METHODS

A field experiment was conducted in a farmer's field located at Guddampatti village near Errabaiyahalli taluk, Dharmapuri district, Tamil Nadu state during July to October-2020, to establish the effect humic acid, micronutrients and growth regulators on the growth, yield and quality of bhendi crop. A composite soil sample for initial analysis was collected from the proposed experimental field before sowing and was air dried in shade, powdered and sieved to pass through a 2 mm sieves, thoroughly mixed and used for analysis of physico-chemical properties by adopting

standard procedures. A field experiments was carried out to study the effect of humic acid, micronutrients and growth regulators on growth, yield and quality of bhendi as well as the nutrient status of post-harvest soil. The experiment was conducted in a randomized block design (RBD) with the following nine treatments and three replications. The treatment details are given below, T1 – Control (recommended dose of NPK) (80:40:40) T2- Humic acid @ 30 kg ha-1 soil application T3- Humic acid + Micronutrients mixture (Cu, Zn, Mn, Fe, Mo, B) @ 50 ppm T4- Humic acid + Growth regulator1 (Gibberellic acid @ 50 ppm) T5- Humic acid + Growth regulator2 (Indole-3 Butyric acid @ 50ppm) T6- Humic acid + Growth regulator3 (Naphthalene acetic acid @ 50ppm) T7- Humic acid + Micronutrients mixture @ 50 ppm+ Growth regulator1 (Gibberellic acid @ 50 ppm) T8- Humic acid + Micronutrients mixture @ 50 ppm+ Growth regulator2 (Indole-3 Butyric acid @ 50 ppm) T9- Humic acid + Micronutrients mixture @ 50 ppm+ Growth Regulator3 (Naphthalene Acetic Acid @ 50 ppm). Each treatment was replicated three times .The field was pulverized well to obtain a good tilth and laid out as per the plan. Individual plots were prepared and leveled as per the plot size before taking up sowing operation. A uniform NPK dose of 80:40:40 kg ha-1 was applied to all the plots through urea, SSP, MOP. Bhendi variety Arka anamika was grown as test crop. Five plants were tagged in each plot used for taking biometric observations and five plants in three replication were allowed by grown up to maturity and harvested on 55 to 65 DAS and 43 utilized for recording DMP. Utmost care was taken to maintain the crop plants from pest and diseases.

RESULTS AND DISCUSSION

Effect of humic acid, micronutrients and growth regulators on the Growth Parameters of bhendi

Among the combined application, the treatments humic acid @ 30 kg ha-1 + micronutrients mixture @ 50 ppm + Growth regulators1 (Gibberellic acid @ 50ppm) (T7) was recorded the highest plant height of 57.71 cm at 30 days, 97.3 cm at 60 days, 138.8 cm at 90 days. However it was found on par with humic acid @ 30 kg ha-1 + micronutrients mixture @ 50 ppm + growth regulators3 (Naphthalene acetic acid @ 50 ppm) (T9) with 57.2 cm at 30 days, 96.8 cm at 60 days, 137.2 cm at 90 days. The lowest plant height was recorded in the treatment T1 (46.3, 67.7, 104.4 cm at 30, 60, 90 days respectively. The number of leaves plant^{-1} of bhendi was noticed and was influenced by the application of same levels of humic acid, micronutrients mixture and growth regulators. The lowest number of leaves plants-1 was noticed in control (T1) with 9.57, 15.10 and 22.40 at 30, 60 and 90 days respectively. The results presented in the table revealed that the combined soil application of humic acid @ 30 kg ha-1 + micronutrients mixture @ 50 ppm + growth regulators1 (Gibberellic acid @ 50 ppm) (T7) recorded the highest leaf area index of 3.72, 5.61, 6.71 at 30, 60, 90 days duly. Among the combined levels of soil application of humic acid @ 30 kg ha-1 + micronutrients mixture @ 50 ppm + growth regulators1 (Gibberellic acid @ 50ppm) (T7) recorded the highest number of branches plants-1 of (3.16). The treatment (T9) humic acid @ 30 kg ha-1+ micronutrients mixture @ 50 ppm + growth regulators3 (Naphthalene acetic acid @ 50 ppm) was on par with T7 (3.15). The least number of branches plant-1 was recorded in T1 (control) 1.41. Among the combined treatments, the highest dry matter production was observed in humic acid @ 30 kg ha-1 + micronutrients mixture @ 50 ppm + growth regulators1(Gibberellic acid @ 50 ppm) was noticed. The DMP varied from 8.04 to 16.13 t ha-1. The highest DMP was recorded in T7 (16.13 t ha-1). This was on par with the treatment, T9 (16.12 t ha-1). The treatments T3, T5 and T8 with 10.54, 11.54 and 14.25 t ha-1 correspondingly. The control (T1) recorded lowest dry matter yield 8.04 t ha-1.

The morphological character (plant height, no of leaves plant-1 and leaf area index) differ due to foliar application of micronutrient mixture. The significant effect of foliar application micronutrient mixture was reported earlier by Polara *et al.,* (2017) which could be due to their role in fundamental processes involved in the cellular mechanism and respiration and it takes part in active photosynthesis. These findings are in good harmony with the reports of Mehraj *et al.* (2015). Increase in growth characters by application of PGR might be due to fact that gibberellins promote the vegetative growth of plant because it involves in the process of rapid cell division and cell elongation these helps in increasing the growth attributes of the plant. Ravat and Makani (2015). This was proved by the present investigation i.e., application of HA @ 30 kg ha-1 + Micronutrient mixture @ 50 ppm + PGR @ 50 ppm resulted in maximum plant height, number of leaves plant-1 and LAI. The highest total soluble solids were observed in (T7) with humic acid @

30 kg ha-1 + micronutrients mixture @ 50 ppm + growth regulators1 (Gibberellic acid @ 50 ppm) (5.05%). The T7 is on par with T9 (5.02 %) with the application of humic acid @ 30 kg + micronutrients mixture @ 50 ppm + growth regulators3 (Naphthalene acetic acid @ 50 ppm). The successive treatments followed are T8>T4 >T6>T5> with 4.71%, 4.01%, 3.82%, 3.68%,

Effect of humic acid, micronutrients and growth regulators on the Quality Parameters of bhendi

The quality parameters of the bhendi *viz.,* ascorbic acid, TSS, titrable acidity, crude protein and crude fibre were significantly improved with the humic acid, micronutrients mixture and growth regulators. Among the combined treatments, the highest ascorbic acid content of 13.73 mg 100 g fruit-1, The highest total soluble solids(5.05%) The highest Titrable acidity content (0.73%), recorded the highest crude Protein (15.31 percent) were recorded in (T7) humic acid @ 30 kg ha-1+ micronutrients mixture @ 50 ppm + growth regulators1 (Gibberellic acid @ 50 ppm). The lowest ascorbic acid content of 8.42 mg 100 g-1 fruit-1 was noticed in control (T1). The best shelf life obtained were noticed at treatments T7 (7.76 days) with soil application of humic acid @ 30 kg ha-1 + micronutrients mixture @ 50 ppm + growth regulators1 (Gibberellic acid @ 50 ppm). It is more vivid that addition of HA improved quality parameters *viz.,* Titrable acidity, Ascorbic acid, crude fibre, Crude Protein and TSS of bhendi crop. The combine application of HA and Mm showed significant effect on quality parameters of bhendi. This increase can be attributed to chelate property of elements such as Na, K, Mg, Ca, Zn, Fe, Cu and other elements which compensates nutrient deficiency and as a result promotes quality and production (Verlinden *et al.,* 2009.

CONCLUSION

Bhendi crop was significantly responded to application of humic acid along micronutrient mixture and PGR. In conclusion, the effect of humic acid along micronutrient mixture and PGR application are safe and as a result, it is effective and easily adopted by farmers. The results of this study showed that application of HA @ 30 kg ha-1 along with Micronutrients mixture @ 50 ppm and GA3 @ 50 ppm have a great potential to increase the growth, mineral contents, quality and yield of bhendi crop, also addition of HA @ 30 kg ha-1 along with Micronutrients mixture @ 50 ppm and Naphthalene acetic acid @ 50 ppm is recommended to bhendi crop due to its comparable performance.

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Table 1: Effect of humic acid, micronutrients and growth regulators on the plant height (cm) at different growth stage of bhendi.

TREATMENTS	plant height (cm)		
	30 DAS	60 DAS	90 DAS
T1 - Control (recommended dose of NPK).	46.3	67.7	104.4
T2- Humic acid @ 30 kg soil application.	47.8	75.8	108.5
T3- Humic acid + Micronutrient mixture (Zn, Fe, Mn, Cu, Mo, B) @ 50 ppm.	49.4	79.2	112.7
T4- Humic acid + Growth regulator1 (Gibberellic acid @ 50 ppm).	54.3	90.4	126.5
T5- Humic acid + Growth regulator2 (Indole-3 Butyric acid @ 50ppm).	50.8	82.5	117.2
T6- Humic acid + Growth regulator3 (Naphthalene acetic acid @ 50ppm).	52.6	86.2	122.4
T7- Humic acid + Micronutrient mixture @ 50 ppm + Growth regulator1 (Gibberellic acid @ 50 ppm).	57.7	97.3	138.8
T8- Humic acid + Micronutrient mixture @50ppm + Growth regulator2 (Indole-3 Butyric acid @ 50 ppm)	55.9	93.6	133.1
T9- Humic acid + Micronutrient mixture @50 ppm + Growth regulator3 (Naphthalene acetic acid @ 50 ppm).	57.2	96.8	137.2
SEd	0.57	1.49	1.69
CD (p=0.05)	1.22	3.15	3.59

Table 2: Effect of humic acid, micronutrients and growth regulators on the Number of leaves plant^{-1} at different growth stage of bhendi.

TREATMENTS	Number of leaves plant^{-1}		
	30 DAS	60 DAS	90 DAS
T1 - Control (recommended dose of NPK).	9.57	15.10	22.4
T2- Humic acid @ 30 kg soil application.	9.88	17.5	24.3
T3- Humic acid + Micronutrient mixture (Zn, Fe, Mn, Cu, Mo, B) @ 50 ppm.	10.15	19.6	26.1
T4- Humic acid + Growth regulator1 (Gibberellic acid @ 50 ppm).	10.79	24.7	30.9
T5- Humic acid + Growth regulator2 (Indole-3 Butyric acid @ 50ppm).	10.39	21.5	27.8
T6- Humic acid + Growth regulator3 (Naphthalene acetic acid @ 50ppm).	10.60	23.2	29.4
T7- Humic acid + Micronutrient mixture @ 50 ppm + Growth regulator1 (Gibberellic acid @ 50 ppm).	11.13	26.2	33.9
T8- Humic acid + Micronutrient mixture @50ppm + Growth regulator2 (Indole-3 Butyric acid @ 50 ppm)	10.95	25.9	32.3
T9- Humic acid + Micronutrient mixture @50 ppm + Growth regulator3 (Naphthalene acetic acid @ 50 ppm).	11.11	26.1	33.6
SEd	0.07	0.08	0.60
CD (p=0.05)	0.15	0.18	1.29

Table 3. Effect of humic acid, micronutrients and growth regulators on the leaf area index at different growth stage of bhendi

TREATMENTS	Leaf area index (LAI)		
	30 DAS	60 DAS	90 DAS
T1 - Control (recommended dose of NPK).	2.01	3.75	4.87
T2- Humic acid @ 30 kg soil application.	2.31	4.07	5.18
T3- Humic acid + Micronutrient mixture (Zn, Fe, Mn, Cu, Mo, B) @ 50 ppm.	2.60	4.38	5.47
T4- Humic acid + Growth regulator1 (Gibberellic acid @ 50 ppm).	3.35	5.16	6.24
T5- Humic acid + Growth regulator2 (Indole-3 Butyric acid @ 50ppm).	2.87	4.66	5.75
T6- Humic acid + Growth regulator3 (Naphthalene acetic acid @ 50ppm).	3.12	4.92	6.01
T7- Humic acid + Micronutrient mixture @ 50 ppm + Growth regulator1 (Gibberellic acid @ 50 ppm).	3.72	5.61	6.71
T8- Humic acid + Micronutrient mixture @50ppm + Growth regulator2 (Indole-3 Butyric acid @ 50 ppm)	3.53	5.38	6.46
T9- Humic acid + Micronutrient mixture @50 ppm + Growth regulator3 (Naphthalene acetic acid @ 50 ppm).	3.69 6.69	5.59	5.59
SEd	0.07	0.08	0.10
CD (p=0.05)	0.15	0.18	0.21

Table 4. Effect of humic acid, micronutrients and growth regulators on the number of branches plant-1 at different growth stage of bhendi.

TREATMENTS	Number of branches plant-1
T1 - Control (recommended dose of NPK).	1.41
T2- Humic acid @ 30 kg soil application.	1.69
T3- Humic acid + Micronutrient mixture (Zn, Fe, Mn, Cu, Mo, B) @ 50 ppm.	1.96
T4- Humic acid + Growth regulator1 (Gibberellic acid @ 50 ppm).	2.71
T5- Humic acid + Growth regulator2 (Indole-3 Butyric acid @ 50ppm).	2.22
T6- Humic acid + Growth regulator3 (Naphthalene acetic acid @ 50ppm).	2.47
T7- Humic acid + Micronutrient mixture @ 50 ppm + Growth regulator1 (Gibberellic acid @ 50 ppm).	3.16
T8- Humic acid + Micronutrient mixture @50ppm + Growth regulator2 (Indole-3 Butyric acid @ 50 ppm)	2.94
T9- Humic acid + Micronutrient mixture @50 ppm + Growth regulator3 (Naphthalene acetic acid @ 50 ppm).	3.15
SEd	0.06
CD (p=0.05)	0.14

Table 5: Effect of humic acid, micronutrients and growth regulators on the ascorbic acid (mg 100 g fruit^{-1}) and total soluble solids (percent brix) of bhendi

TREATMENTS	Quality Parameters		
	Ascorbic acid (mg 100 g fruit-1)	Titrable acidity (percent	Crude protein (per cent
T1 - Control (recommended dose of NPK).	8.42	0.51	6.56
T2- Humic acid @ 30 kg soil application.	9.12	0.54	7.81
T3- Humic acid + Micronutrient mixture (Zn, Fe, Mn, Cu, Mo, B) @ 50 ppm.	9.43	0.56	9.00
T4- Humic acid + Growth regulator1 (Gibberellic acid @ 50 ppm).	11.15	0.67	12.56
T5- Humic acid + Growth regulator2 (Indole-3 Butyric acid @ 50ppm).	10.12	0.62	10.12
T6- Humic acid + Growth regulator3 (Naphthalene acetic acid @ 50ppm).	10.56	0.65	11.31
T7- Humic acid + Micronutrient mixture @ 50 ppm + Growth regulator1 (Gibberellic acid @ 50 ppm).	13.73	0.73	15.31
T8- Humic acid + Micronutrient mixture @50ppm + Growth regulator2 (Indole-3 Butyric acid @ 50 ppm)	12.21	0.69	13.87
T9- Humic acid + Micronutrient mixture @50 ppm + Growth regulator3 (Naphthalene acetic acid @ 50 ppm).	13.52	0.72	13.87
SEd	0.23	0.01	0.02
CD (p=0.05)	0.50	0.03	0.46

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REVIEW ARTICLE

Pharmacological Properties of North Indian Herbs of *Kalanchoe pinnata*

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ABSTRACT

The ultimate goal of this review is to provide the updated pharmacological properties of *Kalanchoe pinnata*. *Kalanchoe pinnat*a is a succulent perennial shrub that grows up to 150cm tall, which belongs to the Crassulaceae family, commonly known to be cathedral bells, air plants, and miracle leaf. *K. pinnata* is the native origin of Madagascar, widely seen in the region of Africa, China, South America, India, and Madagascar. Has many pharmacological properties of Antiallergic, Antirheumatic, Anthelmintic, Antitumor, Immunosuppressive, Hepatoprotective, Antidiabetic, Antipyretic, Antihypertensive, Antiviral, Antimicrobial, Antifungal, Wound healing. Their chemical composition is composed of Alkaloids, Arachidic Acid. It effectively cures Rheumatism, Cancer, Acne, and Acid Reflux. Excessive use may lead to intoxication. In recent years, ethnobotanical and traditional use of natural compounds of plant origin received much more attention towards human health with high efficacy and low toxicity.

Keywords: Perennial shrub, Rheumatism, Traditional plant.

INTRODUCTION

In this modern world people see different diseases so they all line up back towards our traditional herbs to prevent themselves from several diseases, In recent times people have a vast knowledge of the medicinal value and therapeutic uses of our Indian herbs. For generations, herbal drugs are known to have many medicinal uses to prevent and treat many illnesses [1]. Plant-based drugs commonly tend to show fewer adverse effects. This *Kalanchoe*

pinnata is one among them, which belongs to the Crassulaceae family. It is a heavenly plant that consists of several varieties of active chemical constituents and pharmacological activity. The plant has broad leaves shaped like open umbrellas that grow in clusters near the ground. *Kalanchoe pinnata* can be grown outdoors in areas with moderate rainfall from April to September. *Kalanchoe pinnata* can also be grown as an indoor houseplant. The hardy *Kalanchoe pinnata* only need water one to two times a month. The pinnata plant has a significant wound healing activity and anticonvulsant property. They also contain certain anti-cancer, antimicrobial, anti-allergic, analgesic, muscle relaxant, and antipyretic properties.

SYNONYMS [2]

- *Bryophyllum calcicola*
- *Bryophyllum calycinum*
- *Bryophyllum germinans*
- *Bryophyllum pinnatum*
- *Cotyledon calyculata*
- *Cotyledon pinnata*
- *Cotyledon rhizophylla*
- *Crassula pinnata.*
- *Crassuvia floripendia*
- *Kalanchoe brevicalyx*.
- *Kalanchoe calcicole*.
- *Kalanchoe floripendula*

DESCRIPTION

Leaves are elliptically curved in shape, often reddish in colour with thick and fleshy part. leave has the ability to produce bulbils. Stems, roots, leave are produced by the adventitious roots present between the teeth in their margin. This species is well grown for miniature plantlets. it is water absorbing perennial plant which grow throughout the year, flower looks like a reddish tinge [3]. Also commonly known as **cathedral bells, air plant, Goethe plant, life plant.**

Classification [4]

1. Kingdom : Plantae
2. Sub-kingdom : Tracheobionta
3. Divisions : Spermatophyta
4. Sub-division : Magnoliophyta
5. Family : Crassulaceae
6. Genus : *Bryophyllum*

DISTRIBUTION

K. PINNATA belongs to the native of Madagascar [6], it is widely seen in tropical and subtropical areas. It is found in the parts of Asia, Australia, New Zealand, West Indies, Philippines, Hawaii, Brazil [5]. Kalanchoe pinnata is an indoor ornamental plant mostly considered as invasive weed [7] . it is found during the time of genus Bryophyllum discovered.

PHYTOCHEMICAL COMPOSITION

phenols and phenylpropanoids: from the aerial parts of plants, leaves in the form of acids such as caffeic acid, ferulic acid, coumaric acid, para coumaric acid and vanillic acid.

Triterpenoid: are obtained as amyrinacetate, taraxerol, glutinol and many other compounds from the entire plant
Fatty acid: such as stearic acid behenic acid, arachidic acid, linoleic acid, octadecenoic acid and ethyl esters.

Steroids: from aerial parts compounds like *bryophyllol, bryophynol*, bryotoxin a &b
Organic salt : from leaves compounds are complexed between *ahydro amino acid and malic acid*.[12]

CHEMICAL CONSTITUENTS

K. Pinnata is rich in alkaloids, phenols, flavonoids, tannins, anthocyanins, glycosides, bufadienolides,sterols, tocopherol, and sterols. The steroids were discovered from the dried leaves by using dichloromethane and methanol extraction. This plant contains proteins and carbohydrates in high composition along with the traces of sugarsuch as lactose, sucrose, glucose, galactose, fructose, and various hydrocarbons.

WOUND HEALING ACTIVITY

The steroids and antioxidants present in the plant exhibit good wound healing property. It reduces the area of infection and clears the affected region [13].

ANTIOXIDANT ACTIVITY

The ethanol extract derived from the leaved exhibit more flavonoid content compared to other extracts. The abundant contents of flavonoids were believed to show excellent wound healing property. *K. pinnata* can withstand heavy oxidative stress and act as a good antioxidant compared to other antioxidants. The antioxidative agents were designed to protect the body cells from the oxygen groups like peroxyl radicals and peroxynitrile[14].

ANTIHYPERTERRSIVE ACTIVITY

The antioxidant and modulatory effects of plant extract were the reason for antihypertensive activity the extract decrease the arterial blood pressure of anesthetized cats and rats. The blood pressure decreased with increased dose however the study tells that pressure of bioactive compounds causes toxic effects harmful to humans [15].

HEPATOPROTECTIVE ACTIVITY

The ethanolic extract obtained from leaves is extremely useful for using jaundice treated with rats that are subject to chloroform-induced hepatotoxicity. The juice was more effective than ethanolic extract. The antioxidant property is responsible forthe reduction in the accumulation of toxic metabolites [16].

ANTI-TUMOR ACTIVITY

Methanolic and aqueous extracts of the plant were collected and administered in required dosages. The extracts collected reduce the ascitic volume and suppress the tumor growth called the tumor-suppressing agent. Which possesses anti-tumor activity. It is a major environmental hepatocarcinogen because it leads to an increase the oxidative stress and carcinogenesis by disturbing the antioxidant status of free radicals taking place in the liver [17][18].

ANTIVIRAL ACTIVITY

Chloroform extracted from the plant act as an anticancer which is caused by Human Papillomavirus is one of the communicable viruses. The Epstein-Barr virus is responsible for tumour induction and attacks B-lymphocytes. Extraction inhibits the synthesis of viral proteins and also inhibits tumor and viral development [19].

ANTI-DIABETIC ACTIVITY

Diabetes is the major cause of the rise of all cardiovascular diseases such as stroke, and heart attack. The presence of the ethanolic extract of *K. Pinnata* decrease the blood sugar level of rats and increases the pancreatic secretion of pancreatic insulin. Zinc present in the extraction of the plant is used in the treatment of diabetes [20].

ANTI-LEISHMANIAL ACTIVITY

Leishmaniasis was caused by protozoans belonging to the genus of *Leishmania.* The extraction from the plant treats the mice infected with Leishmania amazonensis by decreasing the size of the lesion continuous treatment results show that it not only slows the growth of bacteria but also reduced the level of spreading. The presence of flavonoid and glycoside in the extraction contributes to the antileishmanial activity [21].

INSECTICIDAL ACTIVITY

The extracted methanolic extract from *K. pinnata* yields two bufadienolides which show insecticidal activity against the 1,3,5-orthoacetate which is present in the third instar larvae of the silkworm [22].

ANTI-ALLERGIC ACTIVITY

Mast cells present in the *k. Pinnata* plays a major role against the growth of allergic asthma, aqueous extract in the plant effectually inhibits the mast cell degranulation which prevents allergic airway diseases. Regular intake of extract of *k. Pinnata* results in the prevention of allergen-induced anaphylaxis, the presence of flavonoids is the reason behind the strong anti-allergic property.

ANTIPYRETIC ACTIVITY

This experiment was conducted in hyperthermic conditions for laboratory animals, pyrexia caused by brewer's yeast in rats, thus body temperature was reduced by administrating the hydroalcoholic extract of *k. Pinnata* [23].

ANTILITHIATIC ACTIVITY

Less quantity of oxalate being excreted in the urine causes the development of calcium oxalate stones when the juice of *k. Pinnata* was consumed on regular basis which resulted in the dissolving of stones, it also reduces the amount of oxalate excretion by boosting the citrate excretion [24].

ANTINOCICEPTIVE ACTIVITY

Methanolic extract from the plant is more effective than the drug aspirin, which significantly shows the antinociceptive effect against both chemically and thermally induced pain in mice and also relieves the pain and protects the mice.

CONCLUSION

Indian herbs are having been believed to be medicinal. *K. pinnata* was found in tropical and subtropical areas. This consolidated pharmacological properties of Indian herb *Kalanchoe pinnata* has wound-healing, antioxidant, anticancerous, antiproliferative, antimicrobial, antiviral, antiprotozoal, antileishmanial, anthelmintic, insecticidal, anti-allergic, analgesic, antinociceptive. *K. pinnata* widely used as medicinal plant with high therapeutic value with less toxic and no side effects. And also used as indoor houseplant and ornamental plant. About 25% of drugs used now a days are herbs which used to cure eye pain, stomach disorder, jaundice, wounds, fever, diarrhoea. Few experiments have led to the isolation and determination of the applications of the bioactive compounds from the extraction. Clinical trials carried out tocommerlise the potency of the pharmacological properties of the Indian herb *Kalanchoe pinnata.*

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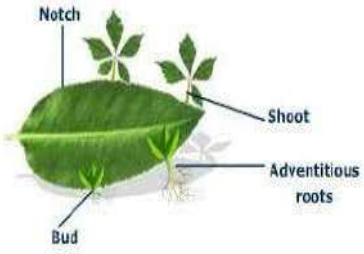
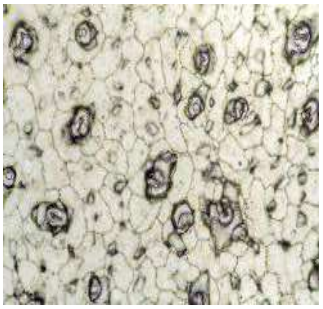
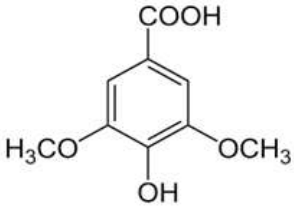
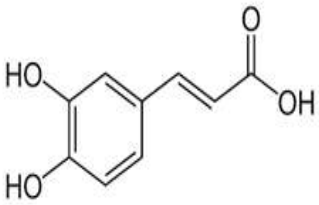
		
Fig. 1. *kalanchoe pinnata* plant	**Fig. 2. *kalanchoe pinnata* Leaves**	**Fig. 3. cell structure of a *Bryophyllum* plant**
		
Fig. 4. Leaves	**Fig.5. Syringic acid**	**Fig.6. Caffeic acid**

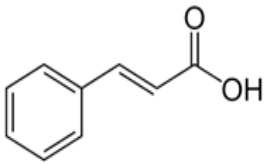
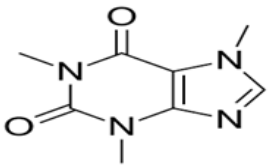
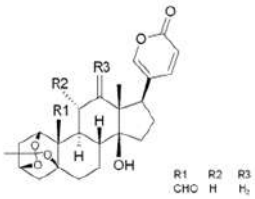

		

Fig.7. Cinnamic acid	**Fig. 8. Apigenin**	**Fig. 9. Bersaldegenin-1,3,5-orthoacetate**

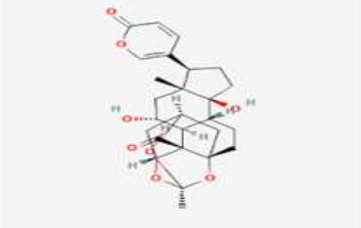
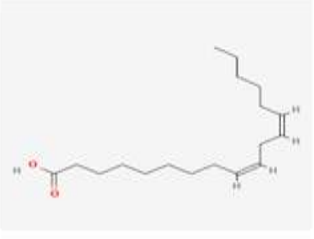
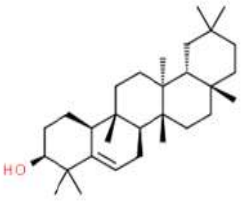

		

Fig. 10: Bryophyllin A	**Fig. 11. Bryophyllin**	**Fig. 12.Glutinol**

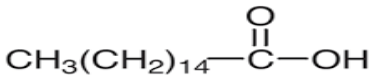
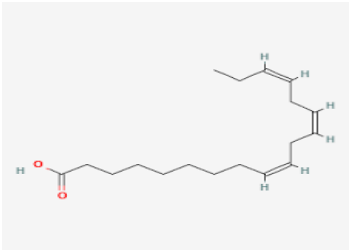
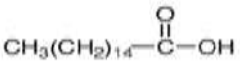
		

Fig. 13 palmitic acid	**Fig.14. Linoleic acid**	**Fig. 15 Malic acid**

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RESEARCH ARTICLE

IoT Transforming the Future of Agriculture Fields

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ABSTRACT

Developing is a huge data division for money related improvement of any country. Control of bigger piece of people of the country like India depends upon agriculture. The present moment, is proposed to develop a Smart Farming System that usages focal points of forefront progresses, for instance, IoT, Wireless Sensor Network and Cloud figuring to help farmers with working on how developing is done. Using sensors like temperature, tenacity, water-level, IR sensors are used to get information about the field and assist farmers with taking careful decisions on pieces of information and recommendations subject to the accumulated data. The water-level sensor, temperature sensor and dampness sensor help with keeping up required water-level in the developing. The water-level in the estate is kept up by means of customized water siphoning motors which is compelled by the microcontroller. The device is IoT enabled by interacting with Wi-Fi using Node MCU.

Keywords: Node MCU, Wireless Sensor Network, water-level sensor, temperature sensor and dampness sensor.

INTRODUCTION

This paper conveys an overall examination of the hypothetical models of the two Smart Farming sub-use cases "Shrewd Greenhouse" and "Brilliant Spraying". Phenomenal highlight is placed on the impact for end-clients. The sub-use case related functionalities were furthermore evaluated with end clients and filed. The planned vested party

are the endeavour accessories inside the Future Internet undertaking and bosses, yet also end clients, for instance, farmers and specialists of agricultural programming who need to be aware of future examples. A critical piece of the results gave right currently procured by client evaluation. Another critical source is a benchmarking study. Last not least huge data was given by the designers of the pilot application, which was also analysed in workspace investigate. The essential trial of the present agri-food region is to satisfy the growing sustenance need and at the same time lessen the normal impression of sustenance creation. The agri-food business has similarly to give more straightforwardness to allow a predominant analysis on how the political, reasonable, social and it are met to prosperity essentials. These goals should be come to by a data driven industry with ICT as a key variable. This paper assessments how the Smart Farming sub-use cases can add to address the troubles of future Agri-sustenance creation. The eventual outcomes of the endorsement of the two pilots with end-clients are presented. The going with part evaluates the monetary, natural and social impact of the Smart Farming use case.. assessments how the pilots can add to an undeniably powerful usage of resources. A couple of thoughts should be offered as a hint or capacity of what isn't strange. Complete numbers require truly executing and conveying the pilots for a greater degree. The item configuration in Smart Farming pilots follow SOA perspective. The two pilots involve a ton of un-related, free coupled organizations that are conveyed as RESTful Web APIs. The Smart Farming pilot conclusions presented in the assumptions 200.3 and 500.5.2 give broad easy to totally finish and through view to the pilots. The explanation and the handiness of each and every module are presented as stories, unmistakable tables, class frameworks and data stream charts. On the most noteworthy mark of these the RESTful Web API portrayals depict the unreservedly open connection points for pariah assist with informing exchange and correspondence. Following the specifics, the fundamental handiness of the item modules can be completed using any programming language that supports REST official.

Problem Statement

The studio focused both on the splendid assistance (initial design) and the sharp sprinkling thoughts with the mean to inspire point by point data of the information needs of the famer in orchestrating and accomplishing a showering task.

Existing System

Agriculture systems are as of now progressively capable, strong, and give redesigned proficiency. An agribusiness area can go from a lone plant in a house, a porch garden, a little estate, to a tremendous developing office. These agrarian robotized structures will help in administering and keep up safe condition especially the country zones. At the present time, propose a sharp Agriculture System (AgriSys) that can take apart a cultivating space and mediate to keep up its abundancy. The structure oversees general agriculture challenges, for instance, temperature, suddenness, pH, and supplement support. In like manner, the structure oversees desert-express troubles, for instance, dust, desolate sandy soil, consistent wind, low suddenness, and the uncommon assortments in diurnal and incidental temperatures. The system interventions are for the most part proposed to keep up the adequacy of the cultivation condition. For a decreased regulator capriciousness, the gathering of soft control is thought of. The system execution relies upon state of-workmanship PC interacting gadgets from National Instruments as tweaked under LabVIEW.

Disadvantages

- The advances in inevitable figuring and the Internet-of-things are to show up at each piece of life including close by agribusiness practices.
- Allowing ranches and other Agri-sustenance on-screen characters to change the information they are passing on.

Proposed System

This moment report is given of the end client endorsements accomplished inside WP200 provided for make Future Internet based sharp developing advancement. The development improvement happened in making two pilots Smart Spraying and Smart Greenhouse. These pilots draw on same creative bases as has been depicted in the D200.2 and in the unavoidable D200.3. The two pilots have been arranged according to a usage driven perspective. This suggests end-clients' requirements in nursery and arable developing activities were perceived and client necessities were

definite as central design targets. Discontinuous arrangement studios and reiterated end-client appraisals during the entire headway process were also polished. The technique of a utilization driven design and evaluation process was conceptualized by a model that was checked V7 model (see D.200.1). The model portrays seven phases through which examination and plan tries are merged to convey a one small step at a time creating structure yield. These methods portray two kinds of tries, i.e., ace-based plan tasks and different construction and appraisal - arranged relationship with end-clients. In the gathering of steps these two sorts of tasks trade intentionally.

Advantages of Proposed System

- Dynamic contraption subordinate organizations license adjusting to changing particular circumstances like the varying framework accessibility.
- Most business practices in the Agri-normal lifestyle are creating data that is rapidly critical for the work cycle control similarly as data that is material for medium to long stretch documentation, uncovering and organizing.

RELATED WORK

System models for the smart farming as part of the IP-based food chain:

The usage driven plan and evaluation the Smart showering pilot thought was first positioned into the setting of the entire advanced lifestyle. A model was developed that shows how the on-screen characters of all the considered three normal lifestyle structures (developing, coordination's, and retail activity) should consider the overall advanced lifestyle challenges, for instance sterilization, condition, moral issues and social tendencies.

End-user needs

The present moment client needs were conceptualized in view of gatherings and focus social events which were finished in five countries inside Work Package 700 of Smart Agri Food adventure. Individuals imparted limitations of present developing situation with at this point available particular stuff and moreover raised their requirements and wants from the future advancement

Integration of external and internal data for tailored spraying services:

Potential is seen when area (for instance more limited size level) information can be successfully connected with the data gave by other expert associations/sources and at the present time much progressively accurate and sensible for guarantee purposes. Miniature environment information organization would be important for neighboring farmers and could make some new business. It is basic to know whether it will rain inside two hour or eight hours. Principal challenge is that assorted equipment doesn't talk with each other. All structures so far have been closed.

Aggregated recommendations for decision making in spraying tasks:

Numerous accommodating ideas for showering task was envisioned and all of them were underlining that most worth can be made assuming the sprinkling is done right when there is a certifiable prerequisite for it. As of now, close by environment information is accumulated from neighborhood little degree environment stations. In any case, there is no extra motivator in social event a comparative information that can be at this point gave by the public environment relationship (for instance through radar pictures). The potential is on dealing with the full-scale environment with scaled down scale environment information. At this moment could give vegetation unequivocal movement ideas.

System Architecture

Above figure shows the architecture of the system.

CONCLUSIONS

The rustic section is of basic importance for the region. It is encountering a method of progress to a market economy, with significant changes in the social, genuine, helper, beneficial and supply set-ups, like the case with each and every region of the economy. These movements have been joined by a reduction in cultivating creation for most countries, and have affected moreover the public seed supply portions of the area. The region has expected to face issues of sustenance flimsiness and a couple of countries have required sustenance help for IDPs and evacuees.Due to the for the most part low section pressure expected for the future, the closeness of a few ideal kinds of airs and other positive factors, including an astoundingly wide regular seed supply region, it ought to be possible to overcome issues of sustenance precariousness in the area with everything taken into account, and even to use this locale to give sustenance to other sustenance insufficient regions. Openings ought to in this manner be made to show up at these results. In order to address the essential objectives impacting the progression of the public and neighborhood seed supplies that are referred to here, the region requires facilitated attempts by all public and all-inclusive accomplices and establishments related with seed supply and plant innate resource the board. On helpful issues, practices advanced by specific countries could be granted to various countries; for instance, on the most capable technique to progress with the change or how to see the mostbrief requirements of farmers. Appropriate methodologies should in like manner be developed, at various levels, to energize seed theory and improvement in the locale.

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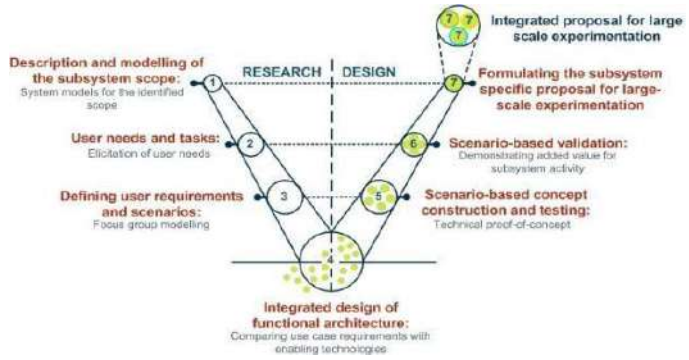

Fig:1 Above figure shows the architecture of the system

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REVIEW ARTICLE

A Review on *Cryptococcus neoformans*: Treatment and Management Strategies

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ABSTRACT

Encapsulated fungal pathogen *Cryptococcus neoformans* has been growing progressively over the last 10 years due to the onset of AIDS and the elevated utilization of immunosuppressive drugs. This review is an aim to highlight some of the previous findings on *Cryptococcus* and different human pathogenic species of *Cryptococcus* as well as what are the treatment options existing in the market. further more we have also discussed what are the virulence factor and how to manage the *Cryptococcus* infections in hospital care setting in infected individuals. *Cryptococcus* is a new era pathogen. It has many deviations from the ordinary yeast species. In this review, we have talked about *Cryptococcus* invasion strategy inside the host cell and as well as their defense mechanism. we have also written some known drugs and their molecular targets present in the cell. ongoing clinical trials and some plant based natural remedies is also discussed here. In this review. As the name given, We have also suggest treatment and management strategy for clinically ill individuals according to CDC and WHO guidelines.

Keywords: Drugs, treatment, infection, fungi, pathogen

INTRODUCTION

Cryptococcus is a *Basidiomycetes* i.e. a fungi like yeast which can be found commonly everywhere around the globe. It is generally present in soil which are mixed with bird dropping or spread through air [1]. There are many species of *cryptococcus* are present like *C. neoformans, C. gatti, C.albidus, C.uniguttvlaus* etc. But only few of them are actually able to cause disease i.e. there are very few species that are pathogenic. One of them is *Cryptococcus neoformans* which is the most common and causes *Cryptococcosis* which generally affects the CNS and causes *cryptococcal* meningitis .it can also be able to affect the lungs. *Cryptococcus* generally not able to affect healthy individual but when an individual became immune-deficient, it can easily infect such individual like in cases of HIV/AIDS or patients who have undergone organ transplantation or any other disease which causes immune system to be weak. Life-

threatening infections as a result of the encapsulated fungal pathogen *Cryptococcus neoformans* had been growing progressively over the last 10 years due to the onset of AIDS and the elevated utilization of immunosuppressive drugs[2]. Another one is *Cryptococcus gatti* which also affects lung severely and it's more virulent than *Cryptococcus neoformans* and can even cause death. The disease caused by *Cryptococcus* has certain categories i.e. pulmonary *cryptococcosis* in immune- competent host or in immune-suppressant host, disseminated non pulmonary non CNS *cryptococcosis* and only CNS *cryptococcosis* and they require antifungal treatments[3].There are some commonly recommended antifungal that we usually used are fluconazole, itraconazole, amphotericin b, flucytosine, ketoconazole, micoconazole etc. Generally when a patient is infected, then first we give amphotericin b to the patient with the mixture of flucytosine then after few weeks if it's still not treated then we give other antifungal. Fluconazole is also one of the preferred antifungal in treatment of this fungi because fluconazole is a synthetic molecule which has antifungal properties. Fluconazole first targets cytochrome P450-mediated sterol C-14 alpha-demethylation which result in the accumulation of fungal 14 alpha-methyl sterols that cause the loss of normal fungal sterols. Sensitivity of demethylation in mammalian cells is lesser towards the fluconazole. There is another one named as itraconazole which inhibits cytochrome P-450dependent enzymes which affects the synthesis of ergosterol . This drugs used for treating *Cryptococcus* meningitis. But these antifungal have some side effects like headache, chest pain ,nausea , difficulty in breathing etc.And some of these drugs are not cheaply accessible for everyone and their course of treatment is also varies from weeks to months which can be fatal in some serious immune-compromised patients. And here we are talking about drugs resistant mechanism which can be understood as if a patient is still suffering from the disease despite being given the medications then that particular drug is no longer be able to counter the pathogen.

There are various drug resistant phenomenon works due to various reasons like body composition like how the infected individual's body is reacting in response to pathogen or the MIC . There can be variation also in the mechanism of action of drugs and in their cellular target like ketoconazole, it is not effective in case of meningitis due to its penetrator ability. Infection related to central nervous system is a bit complicated to treat due to the blood brain barrier. Prevalence of *Cryptococcus* rapidly growing worldwide due to its association with the host immunity. *Cryptococcus* related diseases come up like more than 2 lakhs cases per year and have the rate of mortality more than 80% around the globe. Death due to this disease mostly observe in African continent in sub- saharan region [4]. Even we have many therapies or drugs to treat meningitis but in developing or underdeveloped countries it's still remains a major issue due to lack of facilities or easy and cheap availability. There is increasing need for the new antifungal drugs because of its high mortality rates in immuno-compromised patients specially in cases of diseases like HIV/AIDS and the resistance of drugs by the pathogens. For identifying the toxicity against host and the drug efficiency we need to identify its minimum inhibitory concentration which will helps us in identifying and discovering new antifungal properties and their drug resistance [5]. According to the pubmed search on the "On *Cryptococcus neoformans* : Treatment And Management" we only got 228 search result which clearly indicate that people had talked about it but there is still long way to go in this aspect of *Cryptococcus*.

Cryptococcus Is A New Era Pathogen

It is a fungal infection that primarily affects immune-compromised individuals, but can also affect immuno competent individuals or those with unknown risk factors and it can be life threatening as well. *Cryptococcus* is a *basidiomycetes yeast* and are encapsulated. Thousands of cases of pneumonia are caused by it. It is widely distributed in the environment and causes meningoencephalitis all over the world. Despite significant advancements in antifungal, antibacterial treatments and antiretroviral therapy, cryptococcal meningitis is still linked to growing rates of morbidity and mortality all over the world, and it remains a public health concern. In adults from many countries where there is a high prevalence of HIV, there is a significant clinical and economic burden. *Cryptococcal* meningitis affects about 250,000 people each year with more than 180,000 deaths estimated[6,7].

Host Cell Invasion

There are some common strategies for the growth and viability of the fungus in host and their strategies to influence host and fungus interactions to provoke disease. Generally these strategies require host-specific virulence factors that

leads to pathogenesis also briefly summarize how various fungal pathogens that harm the host. We found that in addition to a core of common growth-related activities, different groups of fungi use different strategies that can lead to disease despite the host response. Host cell invasion is a procedure that includes adhesion accompanied through invasion. Host cell invasion mechanism triggered intracellular invasion and energetic invasion, In addition, fungi can pass epithelial or endothelial cell boundaries through proteolysis of tight junctions among cells. Some pathogenic fungi have developed advanced techniques to avoid the immune system of the host. Several mechanisms to escape seem to work collectively in inhibition of attack via way of means of distinct levels of the adaptive and innate immune reaction. Therefore, after coming into the host, those pathogens need to war to triumph over the immune device to permit them to survive, penetrate and unfold to distinct contamination sites. Therefore, the established order of a success contamination method is carefully associated with the capacity of the immune device to modulate pathogen assault. Most of the techniques used to make the most the immune device are shared amongst distinct fungal species[11].Once a microbe reaches the host, phagocytic cells are the primary line of protection. The main phagocytic cells (neutrophils, dendritic cells, and macrophages) of the innate immune reaction are in charge of controlling the contamination. In phagocytosis, the morphology and length of the pathogen are essential. It is essential that fungi can alternate its morphology throughout distinctive degrees of contamination in reaction to host temperature and spreading. These adjustments boom the demanding situations related to phagocytosis. Morphology will decide how complicated the actin filaments are for a success phagocytosis. In addition, if the microorganism is greater than the phagocytic cell, this method may be compromised. Some research have determined that a few candida species also can develop hyphae outside and inside macrophages, multiply in the cell, damage phagocytic cells, and go out the digestive tract [12,13,14].

Host Defence Strategy

Capsules play important role in many functions such as cytokines down regulation as immune response by host, complement component depletion, monocytes capacity of antigen presenting inhibition. The capsule of Cryptococcus neoformans is made up of complex polysaccharide which synthesize in the cell and move across vesicle to the cell wall and attached to surface of cell with non-covalent bond and arrange in the form of long polymer. By various analysis like NMR ,mass spectroscopy and chromatography, it is studied that it contains primarily GXM (glucuronoxylomannan) and GXMGal (glucuronoxylomannogalactan) [16,17]. If we speak of morphological transition, it consists of yeast to hypha or spore to hypha,in reaction to danger. Equal with poisonous compound manufacturing it entails robustness and pressure resistance with the assist of cell wall and detoxification [12]. Immune evasion may be finished through overlaying of PAMPs such as pill and pigments to break out from immune cells. bofilm formation and translocation is one such phenomenon for epithelial limitations [18]. The complement system is a complex system that performs a position in innate and antibody-mediated microbial contamination resistance. Many triggers, which include foreign molecular styles at the fungal surface, antigen-antigen complexes antibodies, and cell debris, can set off the supplement device and release a series of enzymatic procedures managed through regulatory proteins at some stage in fungal contamination. Inflammatory tissue harm that happens due to contamination. Excessive irritation and tissue harm are avoided through those regulating molecules. Complementation may be brought on at the pathogen floor in 3 ways: classical, lectin, and alternative, every with its very own set of binding molecules and initiators however converge to supply the equal series of effect molecules [19,20,21].

Treatment, Management and Drugs

According to CDC, Weeks before signs of meningitis appear, cryptococcal antigen, a biological marker that indicates a person has cryptococcal disease, can be detected inside the body. Cryptococcal antigen must be tested in people who have advanced stages of HIV infection. Patients who have tested positive for cryptococcal antigen can take antifungal medications to help the body fight the disease in its early stages. It has been demonstrated that using this method lessen the cryptococcal meningitis risk in people who have been exposed to it. To screen human beings living with HIV for early cryptococcal contamination and cryptococcal meningitis, healthcare centres and laboratories need to have easy access to reliable tests. Currently, those tests are unavailable in lots of areas of the world. Improving access to these tests is a critical step toward reducing cryptococcal meningitis deaths. The lateral

flow assay is a reliable, quick, and low-cost test for detecting cryptococcal antigen in a small sample of blood or spinal fluid. More than 95% of the time, the test correctly detects cryptococcal infections. Furthermore, the test does not necessitate expensive laboratory equipment or expertise, making it ideal for low-resource environments. To lessen mortality from cryptococcal contamination, CD4 checking is likewise had to perceive sufferers with low CD4 counts, who're at maximum hazard for cryptococcal meningitis. fluconazole ,Amphotericin B and flucytosine are medicines proven to enhance recovering in individuals with cryptococcus infections[28]. Cryptococcal meningoencephalitis is a critical opportunistic disease that is normally visible amongst people affected by untreated AIDS . The preliminary treatment technique for the affected person with cryptococcal meningoencephalitis consists of an aggregate antifungal remedy with amphotericin B plus flucytosine (for the induction segment of the remedy) observed via the means of fluconazole (for the consolidation and maintenance phases). During remedy, the affected individual must be monitored for recurrence of medical signs that could indicate extended intracranial pressure, relapse of disease (from loss of adherence or drug resistance), negative events associated with antifungal remedies, and immune recuperation syndromes secondary to antiretroviral remedy (ART)[29]. Figure shows different phases of treatment of *Cryptococcus* under clinical settings according to WHO guidelines[30]. According to WHO, there are three steps in treatment therapy for Cryptococcal infection which includes Induction, Consolidation and Maintainence phase.

Induction phase

For all and every age groups required a routine of one week in this induction Phase for the treatment.it includes follow up of fluconazole in the range of 12mg per day and 1200 mg per day for the child and the adults respectively with the prerequistic condition of 100mg per day flucytosine with the combination of 1mg per day Amphotericin-B Deoxy-cholate with multiple dosage each day[30].

Alternatively induction routine includes –

- 12 mg per day and 1200mg per day for child and adults respectively of fluconazole and 1 mg per day amphotericin-B in combination for 14 days.
- 12 mg per day and 1200mg per day for child and adults respectively of fluconazole and 100mg of flucytosine in multiple dosage in combination of both the drugs.

Consolidation phase

800mg of fluconazole recommended for adults and with the maximum limit of 800mg,for children fluconazole recommended in the range of 6 to 12mg per day in this phase.

Maintenance phase(Secondary prophylaxis)

For the maintenance phase, 200 mg fluconazole each day for adults, 6 mg/kg each day for adolescents and children) is recommended (strongly recommended, highly certain evidence). To minimise remedy toxicity due to amphotericin B and flucytosine, a minimal of elctrolyte replacement and preemptive hydration,in addition to toxicity tracking and management, needs to be provided[30]. Amphotericin B is a type of polyene antifungal agent that can kill a wide range of fungal pathogens in vitro . Owing to its binding ability to sterols, particularly ergosterol, amphotericin B has an antifungal effect by disrupting fungal cell wall synthesis, as a result of which pores form, allowing cellular components to leak out. This affinity could also explain why it is toxic to certain mammalian cells. At clinically known concentrations, Amphotericin B is commonly regarded to be a fungicide against susceptible fungi.Despite the advent of more recent antifungal marketers in the remedy of systemic mycoses, The drugs that stays the usual remedy for lots of serious fungal infections is amphotericin B. However, due to toxicities related to its intravenous use, together with the accelerated availability of more secure remedy options, it's often reserved for sufferers who've serious, life-endangering fungal infections or for those whom are not able to endure antifungal marketers. With the exception of neonatal candidiasis and remedy of Candida urinary tract infections, lipid-primarily based totally formulations (maximum significantly liposomal amphotericin B) have in large part changed amphotericin B deoxycholate because of their progressed tolerability[29,32]. Amphotericin B is related to hypomagnesemia, renal insufficiency, hypocalcemia, hypophosphatemia, and hypokalemia. Thus, affected individuals dealt with by amphotericin B must have day-to-day tracking of serum creatinine and electrolytes. Many

affected individuals require huge quantities of potassium and/or magnesium supplementation at some stage of treatment and hydration with regular saline at some stage with infusions of amphotericin B. A lipid-primarily based system of amphotericin B has emerged as the desired polyene in resource-environments and must be in particular used for sufferers who have increased renal insufficiency (e.g., plasma creatinine awareness is more than 2.5 mg/dL) even while receiving amphotericin B deoxycholate or if there are issues with having to break induction remedy because of toxicity. If this isn't always possible, the dose of amphotericin B deoxycholate may be decreased with the aid of using 50 percent or given on a different day. It is important that there may be no interruption of the aggregate routine at some stage in the two-week induction period[33].Fluconazole is the primary antifungal agent used to treat cryptococcal meningitis in many parts of the world, despite substantial evidence that it is associated with suboptimal microbiological and medical outcomes. Fluconazole's mode of action is fungistatic, which means it inhibits growth rather than killing the fungus. We propose that the behaviour of fluconazole is due to the emergence of resistance in *Cryptococcus*, which is no longer detectable using general susceptibility tests, with chromosomal aneuploidy or duplication as the primary mechanism. Resistance develops as a result of drug exposure and the use of clinically associated regimens. As a result, fluconazole (and likely other agents targeting 14-alpha-demethylase) is compromised by intrinsic properties that limit its effectiveness. This resistance, however, is likely to be overcome through dosage escalation or the use of aggregate therapy [34].

Clinical Studies on *Cryptococcus neoformans* Individuals

In sub-Saharan region of Africa, a study done on 111 patients who had *Cryptococcus* meningitis for 2 years. by analysing the plasma sample for CMV Davit was found that out of 111 patients,58 patients were having viral load 498 IU/ml.40% mortality rates were observed in 10 weeks analysis of CMV viremia and 21% observed in without CMV viremia. Half of the patients who have Cryptoccocal meningitis were detected with CMV viremia [35]. One more study done for Asymptomatic cryptococcal antigenemia i.e. ACA in HIV patients. Its prevalence range observed is 1.3 to 3% with different geographical locations around the globe. By primary screening it is observed that ACA probably helps to decrease the *Cryptococcosis* [36,37].

Natural Remedies Against *Cryptococcocus* Species

There are few natural remedies extract from plants parts which can work as potential antifungals. Some of these are like according to one study done on *Cochlospermum regium* (Schrank) Pilger leaves ,it was analyzed that its ethanolic extract shows some antifungal properties and restrict against biofilm activity of *Cryptococcocus gatti* [38]. One more study shows that the plant *Annona coriacea* was used to test for its antifungal properties. Its leaves and bark were extracted using ethanol and tested for *Cryptococcus* species along with some other yeast.it showed growth reduction for species of *Cryptococcus neoformans* and *Cryptococcus gatii*. This shows some positive result and can be tested for alternative for Cryptococcus treatment [39]. In this study, they have used the *Eriobotrya japonica* with the combination of nystatin. The extract of the seeds using methanol is found to be effective for growth reduction of *Cryptococcus neoformans* and for other isolates too. So, it can also be a potentially new antifungal source [40].

CONCLUSION

By above details, we can came to a conclusion that there are many fungi present on human body from outside surface to inside. Some of which are non-pathogenic to healthy host and can only become pathogenic when host became less immune due to various factors. We have studied about the treatment and management protocol and can conclude that *cryptococcus* itself is not a major threat but with combination of other factors and in case of immunodeficient host ,it is deadly and known antifungals are sometimes incapable of protecting from all clinical strains. So, there is need for new antifungals and different approaches which might work for all the pathogenic species of *Cryptococcus*. We also studied about host invasion methods and its defense mechanism briefly and there are certain factors which lack some research to provide any certain function and some research can be done in exploring these factors and mechanism.

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Table: 1 shows some common fungus and their source and disease caused by them

Fungi name	Virulence factor	Source of fungi	Disease name	
Cryptococcus	- Polysaccharide capsule -Mannitol and melanin production	-Inhalation of spores from our surrounding -decayed wood	- Pneumonia -Meningitis disseminated infection	8
Aspergillus	-Melanin -some secondary metabolites	-Inhalation of spores from environment	- Lung diseases - Hematogenously Disseminated infection	9
Candida	- Adhesins and invasions -Biofilm formation	-microbiota on the surface of the skin -gastrointestinal tract	- skin infections -Hematogenously disseminated infection	10

Table 2: Table showing few known drugs and their target

Drugs	target	References
Fluconazole	Inhibits cytochrome P-450 sterol C-14 alpha-demethylation selectively.	22
Amphotericin B	binds to ergosterol and change cell membrane permeability	23,24
Ketoconazole	Stops the synthesis of ergosterol to increase membrane fluidity to stop growth	25
Flucytosine	replaces uracil during fungal RNA synthesis inhibit thymidylate synthetase,DNA synthesis and protein synthesis.	26
Itraconazole	Selectively inhibits cytochrome P-450	27

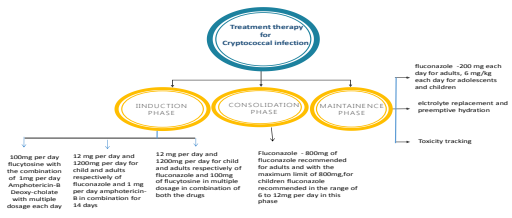

Figure1: shows different phases of treatment of *Cryptococcus* under clinical settings according to WHO guidelines[30].

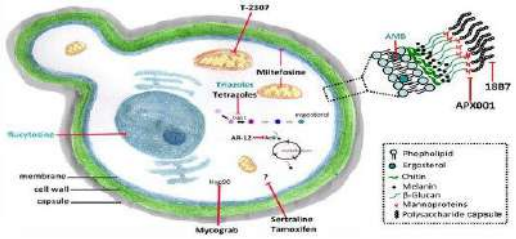

Figure 2: Conventional antifungal and new molecules for cryptococcosis treatment.[31]

Cryptococcus spores are present in air, soil and Pigeon droppings

↓

they can enter in our body through Lungs inhalation

↓

After it , Proliferation takes place in lungs

↓

then it reaches to cross blood brain barrier

↓

and CNS gets infected and Cryptococcal meningitis will occur.

Flow chart 3. shows route of *Cryptococcus* infection in human brain through inhalation of spores through lungs15

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RESEARCH ARTICLE

Assessment of Zooplankton Abundance in Relation to Physico-Chemical Parameters in the Important Lakes of Mysore City, Karnataka State, India

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ABSTRACT

Zooplankton are living capsules of nutrition for the most of commercially cultivated fish species as they meet all the necessary nutrients. With this background the present study was aimed to assess the zooplankton abundance in relation to physicochemical parameters for the period of two years in the surface waters of Dalvoylake, Lingambudhilake, Kukkarahalli lake and Varunalakes of Mysuru city, India. Twelvephysico-chemical parameters of surface water were recorded fortnightly and zooplankton samples were collected simultaneously for the assessment of their abundance. Zooplankton analysis results showed that, the most abundant zooplankton group were phylum rotifera in all four lakes, highest being in Lingambudhilake, followed by Kukkarahalli lake,then to Dalvoy lake and at last Varunalake. The ostracods abundance was lowest in all the four lakes as they show high sensitivity to pollution. Physico-chemical analyses of surface water of all the four lakes showed that, Dalvoy lake was highly polluted, followed by Lingambudhi lake and Kukkarahalli lake and Varuna lake being least polluted. Pollution in Dalvoy lake is due to eutrophication. The physicochemical interrelationship with abundance of zooplankton showed significant correlation which depicted pollution status of water influence the abundance of zooplankton which are main source of food for fishes' growth.

Keywords: Abundance, cladocera, copepoda, crustacean, Dalvoylake, Kukkarahalli lake, Lingambudhilake, rotifera, Varuna lake, zooplankton.

INTRODUCTION

Human activities disturb standing water or lentic (lenis, calm) habitats such as lake, pond, swamp or bog with variable incidents on water, biota and sediments [21]. In the functioning of aquatic ecosystem, zooplankton community acts as food web's major route for energy flux [10].Population of zooplankton varies whenever the human disturbances occur. Zooplankton links with surrounding environments in every part of their life cycle. For that reason, they are water pollution's potential indicators [11].Intake of meat and milk is low in country like India; hence, fish is special supplement to ill- balanced cereal diets. 30-40% of the world population is suffering from protein deficiency in the world. An annual production of only 3.5 million tons of fish protein is provided against 10 million tons of required fish annually to meet the present-day demand of fish protein [24]. For the success of fish culture feeding management is a critical phase. Cost – effective, well-balanced nutritionally complete feeds are zooplankton. To fulfil this for many large fishes and shrimps, zooplankton are actively investigated worldwide [2]. Imantand Novoselov [9],observed changes in the structure-forming complex of zooplankton from 2021-2019 and concluded that, species diversity reaches high values in waters classified as "heavily polluted" and "dirty," which is evidence for a complex structure of zooplankton communities and also stated the main factor influencing the horizontal distribution of the zooplankton abundance is the dissolved oxygen content of water. The study of abundance of zooplankton, due to the change in the environmental conditions in the present scenario, that too which are nutrient capsule for the growing fish which could eradicate malnourishments in the world holds good all forever. Therefore, to the best of my knowledge I felt that, it's of need to study the abundance of zooplankton simultaneously in the important natural lakes of Mysore where fishes has been grown so that most abundant zooplankton group and species could be reared in farms to use as live feed in future with suitable physico-chemical parameters.For planktivorous fish zooplankton are the most important food source [20].Therefore, the present study had been taken to know the most abundant zooplankton group throughout two years to aim in future to culture it to use as a live feed.

MATERIALS AND METHODS

Fortnightly from February, 2018 to January, 2020 surface water samples and zooplankton samples were collected simultaneously in Dalvoy lake, Lingambudhi lake, Kukkarahalli lake and Varuna lake of Mysuru city, India, for twelve physico-chemical parameters analysis such as field pH, Biological Oxygen Demand (BOD), Dissolved oxygen (DO), Carbon di-Oxide (CO_2), calcium, chloride, nitrate, sulphate, turbidity, conductivity, water temperature and alkalinity following Trivedi and Goel [25] prescribed methods. Readings were recorded along with abundance analysis of zooplankton using zooplankton net mesh of 100µm for all four lakes. Abundance of zooplankton was determined by counting animals in Sedgwick-Rafter chambers (1ml), following the procedure of Wetzel and Likens (2000) and expressed as Org/L. One hundred liter of water samples were collected between 6:00 am to 8:00 am, twice a month from February 2018 to January 2020from each sampling site and filtered through60µm mesh size net. Soon after collection, concentrated zooplankton sample were fixed and preserved using 4% formalin. The enumeration of zooplankton abundance was performed by following the modified Sedgwick Rafter cell counting method as followed by Kamaladasa and Jayatunga[12]. One ml of the concentrated sample from each sampling site was transferred into Sedgwick Rafter cell counting chamber and observed under Olympus binocular microscope. The abundance of four groups of zooplankton was carried out using the following formula as given in American Public Health Association(APHA) [3] and Kamaladasa and Jayatunga [12].

No. of Organism / m^3 = $\frac{C \times V1}{V2 \times V3}$

Where,

C= Number of organisms counted
V1 = Volume of concentrated sample (50ml)
V2 = Volume of Sample counted (5ml)
V3 = Volume of grab sample ($0.1m^3$)

Finally, to obtain organism /L, the number of organisms per m^3 was divided by1000.

RESULTS AND DISCUSSION

The most abundant zooplankton group were phylum rotifera in all four lakes (table 1), highest being in Lingambudhi lake [graph I (a)] which is showing the negative co-relation to DO (table 4), followed by Kukkarahalli lake (table 1), showing the negative co-relations to turbidity, DO and calcium (table 5), then in Dalvoy lake and at last in Varunalake (table 1) with no significant relationship with any physicochemical parameter (table 3 and table 6). Physico-chemical analyses showed that, Dalvoy lake was highly polluted, followed by Lingambudhi lake and Kukkarahalli lake (table 2). The least polluted lake is Varuna. In Dalvoy lake abundance of rotifers were followed by cladocerans(table 1) showing no significance relationship with any of physico-chemical parameters, then copepods which is showing negative co-relation with water temperature and chloride, and at last ostracod showing positive co-relation with conductivity, DO and nitrate (table 3). In Lingambudhi lake which is merely polluted rotifers were more in number as mentioned earlier followed by cladocerans showing the positive co-relation with water temperature, and negative co-relation with field pH and then, copepods showed the positive co-relations with turbidity, conductivity, alkalinity, DO, CO_2, calcium, chloride and sulphate, whereas, ostracods co-relation was non-significant in Lingambudhi lake and least abundant (table 4). Moderately polluted Kukkarahalli lake revealed the same result as Dalvoy lake in abundance of zooplankton groups with copepod showing negative co-relation with water temperature, turbidity, conductivity and nitrate but contrastingly to the BOD. Ostracods of Kukkarahalli lake showed the negative co-relation with field pH, alkalinity and chloride (table 5). Varuna lake which is the least polluted has abundant rotifer, followed by copepods, cladocerans and ostracods abundance (table 1).

Canonical Correspondence Analysis (CCA) of Zhang *et al.,* [26]studies revealed that, abundance of zooplankton significantly affected by changes in the water environment. Manickam *et al.,*[17]study suggested that, the higher zooplankton population might be due to temperature acceleration and abundance of rotifers was the most in their study site and present study echoed the same result. Studies on abundance of zooplankton by Savitha and Yamakanamaradi [22] in three lakes of Mysore showed that, the abundance of rotifer is most in all the three sampling lakes but not diversity assembling the same result as present study. Abundance of rotifer species fluctuates most according to physico-chemical parameters of the environment Karuthapandi*et al.,*[13]. Koli and Muley [14] study revealed that, dramatic abundance changes in zooplankton community are observed as a response to change in physicochemical properties of water bodies, which had shown similar result in present study too, where, physicochemical parameters such as water temperature and chloride in Dalvoy lake affects copepod abundance and ostracods abundance affected by conductivity and nitrate which is resembling Savitha and Yamakanamaradi [22] results on Dalvoy lake. The study of Koorosh and Yamakanamaradi [15] on Lingambudhi lake revealed that, nitrate influence the abundance of rotifers in contrasting to that, present study did not show any significance with rotifers abundance and physicochemical parameters. The abundance of cladoceransis affected by COD, turbidity and water temperature in their study, where as in present study along with water temperature field pH also showing affecting the abundance but COD and BOD doesn't show any significance. Copepods abundance hugely affected by DO, CO_2, turbidity, conductivity, calcium, chloride and sulphate in current study where as Koorosh and Yamakanamardi [16]study reveals that, COD, nitrate, chloride and alkalinity. Beenamma and Yamakanamaradi [4] study on the abundance zooplankton in Kukkarahalli lake revealed that, the turbidity and phosphate content decide the abundance of all group of zooplankton, current results reflect the same. Deepthi and Yamakanamaradi [8] study on Varunalake showed that, the group micro crustaceans ostracods abundance was lowest as they show high sensitivity to pollution in the current study too.

For understanding water pollution status zooplankton are the best bioindicators [7].Released effluents from the industries and degradation of environment are clasping hands [23].Out of the four lakes the highest pH value in Varunalake is due to micro and macro vegetation's photosynthetic activity just as concluded by Chinnaiah *et al.,*[6] in their studies on Adilabad lakes. pH, DO high value, nitrate, sulphate, turbidity and conductivity low value indicates

good water quality. The pH decreases from Varuna lake to Kukkarahalli lake, then to Lingambudhi lake and lowest in Dalvoy lake. This indicates the number of micro and macro vegetation's photosynthetic activity being very less in Dalvoy lake. Dalvoy lake also showed the highest BOD value, resembling the Sankar *et al.,*[19] and Bheemappa *et al.,*[5]studies to support the obtained results which in turn could sayhigher the BOD value maximum consumption of oxygen thus higher pollution load which also echoes Deepthi and Yamakanamardi[8] studies. Supporting the same result in Dalvoy lake Abhilash and Mahadevaswamy [1]concluded that, high value of BOD might be steady inflow of domestic and industrial waste.

CONCLUSION

The above two years study conclude that the abundance of zooplankton had been influenced by many environmental variables and the moderately tolerated zooplankton can be chosen to culture in the lab for the purpose of live feed for the fishes. Crustaceans were abundant in all the four lakes irrespective of their pollution status and preferred food by fishes due to their small size unlike rotifers. Therefore, it is suggested that, second abundant cladocerans could be used to culture in laboratory to use as a life feed.

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CONFLICT OF INTEREST

No conflict of interest.

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Table 1: Abundance of zooplankton groups in the surface waters of Dalvoy, Lingambudhi, Kukkarahalli and Varuna Lakes (February 2018 to January 2020)

Lakes	Zooplankton groups (Org/L) mean ± SE			
	Rotifer	Cladocera	Copepoda	Ostracod
Dalvoy lake	43.77 ± 0.74^{c}	31.50 ± 0.90^{c}	18.89± 0.71^{c}	11.08 ± 0.53^{b}
Lingambudhi lake	227.91 ± 4.05^{a}	66.02 ± 2.42^{b}	29.43 ± 3.34^{b}	16.18± 1.25^{a}
Kukkarahalli lake	152.79 ± 2.92^{b}	72.54 ± 2.96^{a}	64.14 ± 2.87^{a}	17.22 ± 1.29^{a}
Varuna Lake	4.43 ± 0.41^{d}	2.85 ± 0.26^{d}	4.16 ± 0.29^{d}	1.81 ± 0.12^{c}
ANOVA	1621.79	269.77	130.23	55.55
F Value (df=3, 188)	P<0.000	P<0.000	P<0.000	P<0.000

Note: Mean values with same superscript letters in the given column are not significantly different, where as those with different superscript letters are significantly (P<0.05) different as judged by Duncan's multiple test, df = degree of freedom.

Table 2: Physico-chemical parameters in waters of Dalvoy, Lingambudhi, Kukkarahalli and Varuna Lakes (February 2018 to January 2020

Lakes	Physico-chemical parameters (Mean ± SE)											
	Field pH	BOD	DO (mg/L)	CO_2 (mg/L)	Calcium (mg/L)	Chloride (mg/L)	Nitrate (mg/L)	Sulphate (mg/L)	Turbidity (NTU)	Conductivity (µS/cm)	Water Temperature (°C)	Alkalinity (mg/L)
Dalvoy lake	6.08 ± 0.06^{c}	53.73 ± 0.45^{a}	2.57 ± 0.04^{d}	22.00 ± 0.22^{a}	22.97 ± 0.27^{b}	56.74 ± 0.90^{a}	3.05 ± 0.11^{a}	48.60 ± 8.68^{a}	13.54 ± 0.15^{a}	906.89 ± 8.98^{a}	21.16 ± 0.44^{a}	643.00 ± 3.51^{a}
Lingambudhi lake	7.88 ± 0.09^{b}	31.69 ± 0.53^{b}	5.52 ± 0.18^{c}	8.31 ± 0.20^{b}	25.18 ± 0.48^{a}	38.49 ± 0.98^{b}	0.90 ± 0.04^{b}	29.41 ± 0.45^{b}	8.38 ± 0.23^{b}	671.37 ± 13.69^{b}	19.54 ± 0.32^{b}	463.77 ± 11.08^{b}
Kukkarahalli lake	8.56 ± 0.09^{a}	9.88 ± 0.77^{c}	7.05 ± 0.11^{b}	0.00 ± 0.00^{c}	24.97 ± 0.62^{a}	35.52 ± 0.47^{c}	0.75 ± 0.06^{b}	26.89 ± 0.53^{b}	6.51 ± 0.16^{c}	524.16 ± 7.94^{c}	20.98 ± 0.31^{a}	425.20 ± 13.68^{c}
Varuna Lake	8.45 ± 0.091^{a}	3.98 ± 0.25^{d}	8.65 ± 0.08^{a}	0.00 ± 0.00^{c}	24.78 ± 0.84^{a}	37.51 ± 1.15^{bc}	0.49 ± 0.03^{c}	22.80 ± 0.41^{b}	4.43 ± 0.15^{d}	479.95 ± 6.63^{d}	21.18 ± 0.43^{a}	382.25 ± 12.35^{d}
ANOVA F Value (df=3, 188)	171.64 P<0.000	1768.94 P<0.000	465.53 P<0.000	4643.30 P<0.000	2.94 P<0.034	115.96 P<0.000	258.24 P<0.000	6.88 P<0.000	467.31 P<0.000	394.39 P<0.000	4.17 P<0.007	110.50 P<0.000

Note: Mean values with same superscript letters in the given column are not significantly different, whereas those with different superscript letters are significantly (P<0.05) different as judged by Duncan's multiple test, df = degree of freedom, NTU Nephelometric Turbidity Unit.

Table 3: Co-relationship between Physico-chemical parameters with the abundance of zooplankton groups in Dalvoy lake(February 2018 to January 2020)

Sl.No.	Physico-chemical parameters	Rotifer	Cladocera	Copepoda	Ostracod
1	**Water Temperature (°C)**	NS	NS	-.323*	NS
2	**Field pH**	NS	NS	NS	NS
3	**Turbidity (NTU)**	NS	NS	NS	NS
4	**Conductivity(µS/cm)**	NS	NS	NS	.304*
5	**Alkalinity (mg/L)**	NS	NS	NS	NS
6	**BOD**	NS	NS	NS	NS
7	**DO (mg/L)**	NS	NS	NS	.317*
8	**CO_2 (mg/L)**	NS	NS	NS	NS
9	**Calcium (mg/L)**	NS	NS	NS	NS
10	**Chloride (mg/L)**	NS	NS	-.312*	NS
11	**Nitrate (mg/L)**	NS	NS	NS	.370**
12	**Sulphate (mg/L)**	NS	NS	NS	NS

Note: ** Correlation is significant at the 0.01 level (2-tailed), * Correlation is significant at the 0.05 level (2-tailed). NS - Non-Significant. DO - Dissolved, BOD - Biological Oxygen Demand; CO_2 - Carbon Dioxide, NTU- Nephelometric Turbidity Unit

Table 4: Co-relationship between Physico-chemical parameters with the abundance of zooplankton groups in Lingambudhi lake(February 2018 to January 2020)

Sl.No.	Physico-chemical parameters	Rotifer	Cladocera	Copepoda	Ostracod
1	Water Temperature (°C)	NS	.342*	NS	NS
2	Field pH	NS	-.293*	NS	NS
3	Turbidity (NTU)	NS	NS	.786**	NS
4	Conductivity(µS/cm)	NS	NS	.474**	NS
5	Alkalinity (mg/L)	NS	NS	.668**	NS
6	BOD	NS	NS	NS	NS
7	DO (mg/L)	-.314*	NS	.768**	NS
8	CO_2 (mg/L)	NS	NS	.525**	NS
9	Calcium (mg/L)	NS	NS	.483**	NS
10	Chloride (mg/L)	NS	NS	.832**	NS
11	Nitrate (mg/L)	NS	NS	NS	NS
12	Sulphate (mg/L)	NS	NS	.495**	NS

Note: ** Correlation is significant at the 0.01 level (2-tailed), * Correlation is significant at the 0.05 level (2-tailed). NS –Non-Significant. DO – Dissolved, BOD – Biological Oxygen Demand; CO_2- Carbon Dioxide, NTU- Nephelometric Turbidity Unit.

Table 5: Co-relationship between Physico-chemical parameters with the abundance of zooplankton groups in Kukkarahalli lake(February 2018 to January 2020)

Sl.No.	Physico-chemical parameters	Rotifer	Cladocera	Copepoda	Ostracod
1	Water Temperature (°C)	NS	NS	-.494**	NS
2	Field pH	NS	NS	NS	-.358*
3	Turbidity (NTU)	-.468**	NS	-.484**	NS
4	Conductivity(µS/cm)	NS	NS	-.557**	NS
5	Alkalinity (mg/L)	NS	NS	NS	-.556**
6	BOD	NS	NS	.489**	NS
7	DO (mg/L)	-.290*	NS	NS	NS
8	CO_2 (mg/L)	[a]	[a]	[a]	[a]
9	Calcium (mg/L)	-.469**	NS	NS	NS
10	Chloride (mg/L)	NS	NS	NS	-.296*
11	Nitrate (mg/L)	NS	NS	-.460**	NS
12	Sulphate (mg/L)	NS	NS	NS	NS

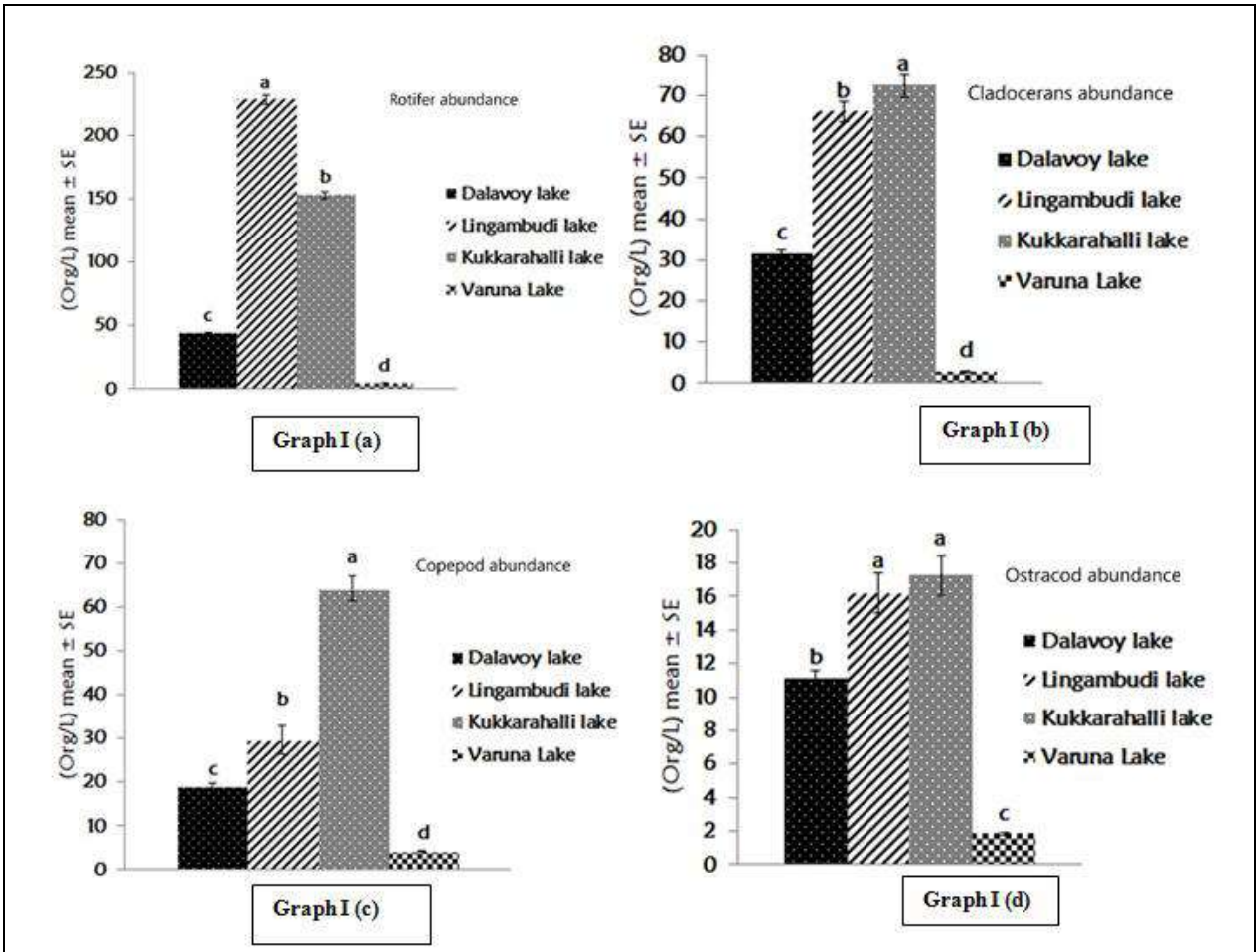
Note: ** Correlation is significant at the 0.01 level (2-tailed), * Correlation is significant at the 0.05 level (2-tailed), [a]cannot be computed because at least one of the variables is constant. NS –Non-Significant.DO – Dissolved, BOD – Biological Oxygen Demand; CO_2- Carbon Dioxide, NTU- Nephelometric Turbidity Unit.

Table 6: Co-relationship between Physico-chemical parameters with the abundance of zooplankton groups in Varuna Lake (February 2018 to January 2020)

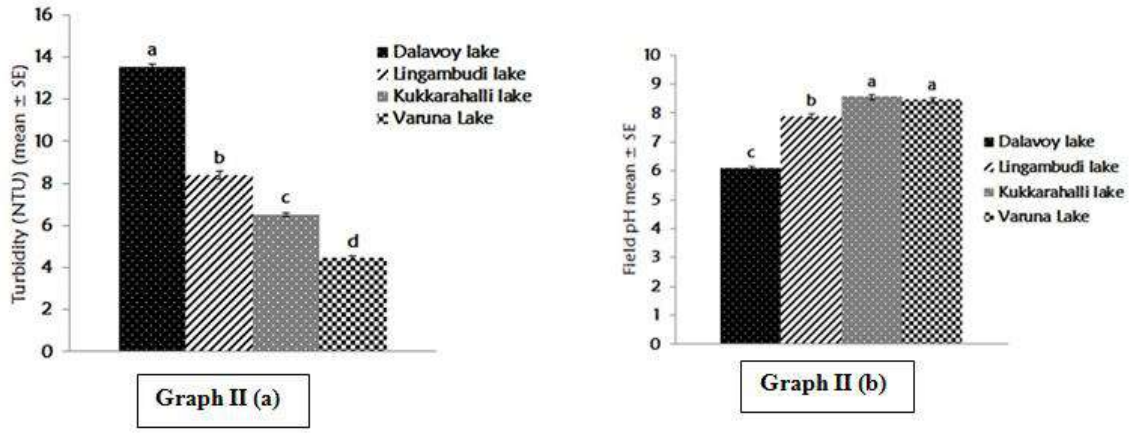
Sl.No.	Physico-chemical parameters	Rotifer	Cladocera	Copepoda	Ostracod
1	Water Temperature (°C)	NS	NS	NS	NS
2	Field pH	NS	NS	NS	NS
3	Turbidity (NTU)	NS	NS	NS	NS
4	Conductivity(µS/cm)	NS	NS	NS	NS
5	Alkalinity (mg/L)	NS	NS	NS	NS
6	BOD	NS	NS	NS	.291*

7	**DO (mg/L)**	NS	NS	NS	NS
8	**CO_2 (mg/L)**	.a	.a	.a	.a
9	**Calcium (mg/L)**	NS	NS	NS	NS
10	**Chloride (mg/L)**	NS	NS	NS	NS
11	**Nitrate (mg/L)**	NS	NS	-.303*	NS
12	**Sulphate (mg/L)**	NS	NS	NS	NS

Note: * Correlation is significant at the 0.05 level (2-tailed), [a]cannot be computed because at least one of the variables is constant. NS –Non Significant, DO – Dissolved, BOD – Biological Oxygen Demand; CO_2 Carbon Dioxide, NTU-Nephelometric Turbidity Unit.

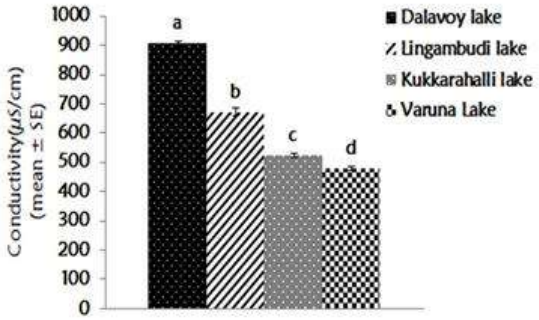


Graph I(a), I(b), I(c) and I(d) shows the comparative abundance of rotifers, cladocerans, copepods and ostracods repectively in all the four lakes of Mysuru city



Graph II (a)

Graph II (b)



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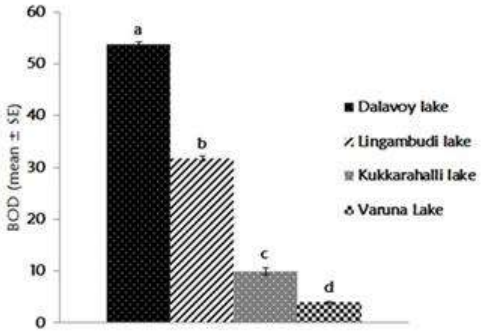
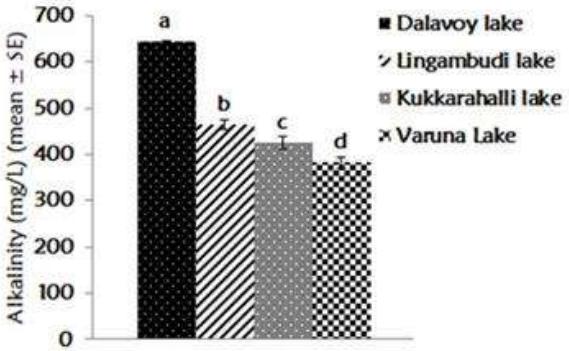
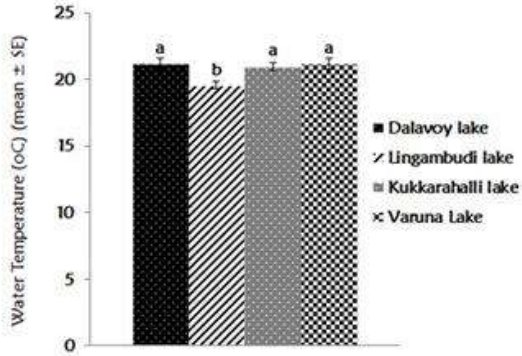


Graph II (d)

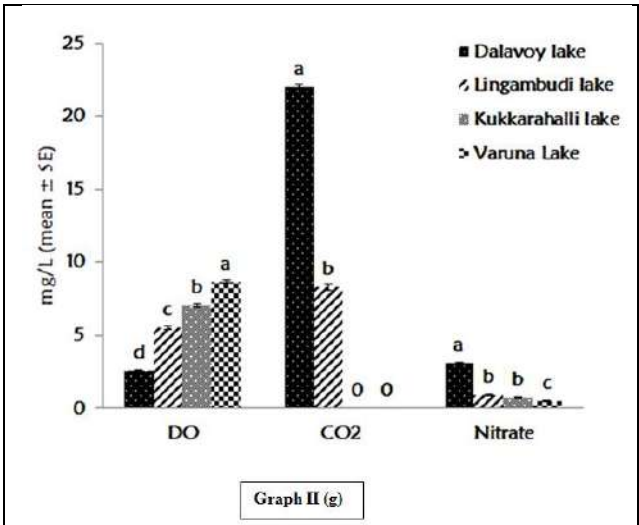


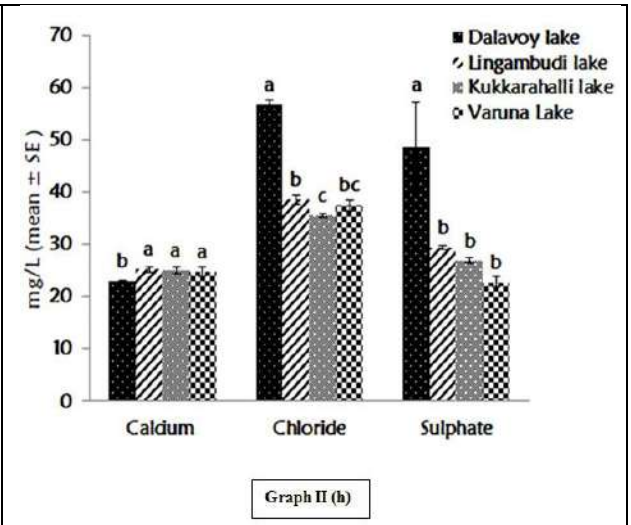
Graph II (e)



Graph II (f)

Graph II(a), II(b), II(c), II(d), II(e) and II(f) shows the comparative analysis of turbidity, field pH, conductivity, BOD, alkalinity and water temperature of surface water of Dalvoy, Lingambudhi, Kukkarahalli and Varuna lakes respectively





Graph II(g)shows the comparative analysis of DO, CO_2, nitrate between lakes and II(h), shows the comparative analysis of calcium, chloride and sulphate of surface water of Dalvoy, Lingambudhi, Kukkarahalli and Varuna lakes respectively

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RESEARCH ARTICLE

Password Analysis Based on Secured Graphical Data Models of Image Choice and OTP

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ABSTRACT

To plan and improvement CaPGP to address various security issues out and out, for example, web based speculating assaults, transfer assaults. It offers sensible security and ease of use and seems to fit well for certain viable applications for working on web-based security. Numerous security natives depend on hard numerical issues. Involving hard AI issues for security is arising as an interesting new worldview, yet has been underexplored. In this paper, we present another security crude in light of hard AI issues, specifically, an original group of graphical secret key frameworks based on top of Puzzle innovation, which we call Puzzle as graphical passwords (CaPRP). CaPRP is both a Puzzle and a graphical secret word conspire. CaPRP tends to various security issues out and out, for example, internet speculating assaults, transfer assaults, and, whenever joined with double view innovations, shoulder-riding assaults. Strikingly, a CaPRP secret phrase can be viewed as just probabilistically via programmed on the web. speculating assaults regardless of whether the secret key is in the pursuit set. CaPRP additionally offers a clever way to deal with address the notable picture area of interest issue in well known graphical secret word frameworks, for example, Pass Points, that frequently prompts feeble secret key decisions. CaPRP isn't a panacea, however it offers sensible security and convenience and seems to fit well for certain useful applications for working on internet based security.

Keywords: graphical passwords, speculating assaults, Puzzle innovation, graphical secret word frameworks.

INTRODUCTION

Private and sensitive information about everyday presence I sending up being progressively more placed away and passed across on the web. People can now access such critical data essentially all portions of their life — banking, shopping, security, clinical records, and so on — basically by sitting at their PC and forming a username and secret key into a site. Access controls exist to thwart unapproved access. Associations should ensure that unapproved access isn't allowed and also supported clients can't make trivial changes. The controls exist in a grouping of designs, from Unmistakable verification Badges and passwords to get to approval shows and wellbeing endeavours .

Existing System

Security natives depend on hard numerical issues. Involving hard AI issues for security is arising as an interesting new worldview, yet has been under explored. A Fundamental errand in security is to make cryptographic natives in view of hard numerical issues that are computationally recalcitrant.

Disadvantages Of Existing System

This worldview has made quite recently a restricted progress as contrasted and the cryptographic natives in light of hard numerical questions and their wide applications. Utilizing hard AI (Artificial Intelligence) issues for security, at first proposed is an astonishing new worldview. Under this worldview, the most remarkable crude developed is Puzzle, which recognizes human clients from PCs by introducing a test.

Proposed System

We present one more security unrefined considering hard AI issues, to be explicit, a unique gathering of graphical mystery word structures in light of top of Puzzle advancement, which we call Puzzle as graphical passwords (CaPRP). CaPRP is both a Puzzle and a graphical mystery key arrangement. CaPRP keeps an eye on different security issues all around, for instance, web estimating attacks, hand-off attacks, and, at whatever point got together with twofold view progresses, shoulder-riding attacks. Conspicuously, a CaPRP secret word can be found just probabilistically through customized web guessing attacks whether or not the mystery expression is in the request set. CaPRP also offers a unique method for managing address the eminent picture area of interest issue in notable graphical mystery state systems, for instance, Pass Points, that every now and again prompts weak mystery key choices. CaPRP isn't a panacea, but it offers reasonable security and convenience and appears to fit well for specific sober minded applications for working on web based security. We present model CaPRPs in light of both message Puzzle and picture affirmation Puzzle. One of them is a text CaPRP wherein a mystery key is a plan of characters like a text secret key, but entered by tapping the ideal individual gathering on CaPRP pictures. CaPRP offers protection against online word reference attacks on passwords, which have been for long time a huge security risk for various web based organizations. This peril is limitless and considered as a top organization danger. Shield against online word reference attacks is a more honest issue than it could appear.

Advantages of Proposed System

It offers sensible security and convenience and seems to fit well for certain pragmatic applications for working on web-based security. This danger is far reaching and considered as a top network protection risk. Guard against online word reference assaults is a more inconspicuous issue than it could show up. Puzzle Login (top of Puzzle innovation Using numerical issues). Picture Puzzle Solving Using AES Algorithm.

RELATED WORK

Puzzle Login

The security and convenience issues in text-based Login and secret word plans have brought about the advancement of Puzzle secret word plans as a potential other option. We can imagine the total 1+2+3+...+n as a triangle of character. Numbers which have such an example of character are called Triangle (or three-sided) numbers, composed T(n), the amount of the whole numbers from 1 to n time Using Factorial base Login Puzzle Solving.

Random Captcha Selection

A CAPTCHA is a test that is utilized to isolate people and machines. Manual human test means "Totally Automated Turing test to differentiate Computers and Humans." It is ordinarily a picture test or a basic science issue which a human can peruse or settle, yet a PC can't. It is made to prevent PC programmers from utilizing a program to consequently set up many records, for example, email accounts. It is named after mathematician. Every individual is picked arbitrarily and altogether by some coincidence, to such an extent that every individual has a similar likelihood of being picked at any stage during the inspecting system, and every subset of n people has a similar likelihood of being picked for the example as some other subset of n people This cycle and method is known as basic irregular examining, and ought not be mistaken for orderly arbitrary testing. A basic irregular example is an unprejudiced studying strategy.

Image Puzzle Solving

we concentrate on the most proficient method to forestall DoS/DDoS attackers from swelling their riddle settling capacities. To this end, we present another client puzzle alluded to as programming puzzle. Dissimilar to the current client puzzle plans, which distribute their riddle calculations ahead of time, a riddle calculation in the current programming puzzle plot is arbitrarily produced solely after a client demand is gotten at the server side and the algorithm is created to such an extent that: 1) an assailant can't set up an execution to address the riddle ahead of time and 2) the aggressor needs significant exertion in deciphering a focal handling unit puzzle programming to its practically identical GPU variant to such an extent that the interpretation isn't possible continuously. In addition, we tell the best way to carry out programming puzzle in the nonexclusive server-program model.

OTP Generation

A one-time secret key (OTP) is a secret word that is substantial for only one login meeting or exchange, on a PC framework or other computerized gadget. OTPs stay away from various deficiencies that are related with conventional (static) secret word based validation; various executions additionally consolidate two component confirmation by guaranteeing that the one-time secret word expects admittance to something an individual has, (for example, a little key ring coxcomb gadget with the OTP mini-computer incorporated into it, or a smartcard or explicit cell phone) as well as something an individual knows (like a PIN).

CONCLUSIONS

The item puzzle may be founded on a data puzzle, it might be composed with any momentum server-side data puzzle scheme, and really conveyed as the ebb and flow client puzzle schemes do. CAPTHCHA is for the most part research field go about as web rectifier to get web applications by perceive human from bots. Manual human test presented which will additionally foster deterrent of math investigation CAPTCHA. By use, Boolean undertakings and enunciations instead of numerical and differential limit which will assist in decline the complexity of CAPTCHA and help effortlessly of purpose and security when diverged from math investigation CAPTCHA. Boolean CAPTCHA can be really use by instructed client. No need of specific capacity, by using academic mind to settle this CAPTCHA and help with lessening time multifaceted design.

Future Works

In the creators concentrate on how great people are at settling notable manual human tests utilizing Mechanica Detecting and eliminating lines is a very much concentrated on field in PC vision since the '70s. Two notable and effective calculations that can be utilized against manual human tests with lines are the Canny discovery and the Hough Transform Removing noise utilizing a Markov Random Field (Gibbs) was presented in Many picture descriptors have been proposed over the last decades :one of the first and most utilized descriptors is the Harris Corner detector presented . In any case, as of late it has been supplanted by additional intricate descriptors that are unfeeling toward scalend pivot (somewhat).

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RESEARCH ARTICLE

Indian Food Licensing Registration System: Past and Present

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ABSTRACT

India is known to have high density of population, the need for food and food products is enormous, and once food items reach the public, they must be entirely safe and effective. However, these features are governed by the Food Safety and Standard Authority of India (FSSAI) under the Food Safety and Standards Act (FSSA) of 2006. Food business operators (FBOs) should have the required license to promote their products and operate a food business. The focus of the study is to exemplify past and current scenarios of food licensing and registration system, as well as the detailed approval procedure to be followed for registration along with the required documents, the procedure for migration from old registration system to current system, and the labelling requirements for food products. The renewal method is briefly described, as well as the types of offences and their associated penalties.

Keywords: Food Safety Standard act, Food Safety and Standard Authority of India, Food Safety Compliance System, Licensing and registration.

INTRODUCTION

According to the latest census report, Indian stands second position in human population 1.4 billion in the world. Regulating the food business India remains challenging due to a variety of factors including, high density of the population [Density remain 464 per Km2], practice of wide variety of food habits in different regions, various climatic changes. After independence, food was regulated under various ministry, department, acts and orders. For example, prevention of food adulteration act 1954, Meat Food Products Order 1973, Milk and Milk Products Order 1992. These acts were regulated majorly under ministry of health and family welfare, ministry of food processing industries, ministry of chemicals and fertilizers [1]. As a result of this, food business operation find more complexity in dealing executing the business. In 2006, government consolidated all the above acts and orders into an act under the supervision of the Ministry of Health and Family Welfare named Food Safety and Standards Act (FSS Act). The main objective of the act was to lay down the food safety standards, accreditation of laboratories through structured guidelines and support the central government with scientific and technical assistance, Alignment with international principles in order to develop high-quality food standards, disseminating information and raising awareness about the safety standard norms in India. Searching, gathering, assembling, analysing and summarization of data regarding contamination of food, food consumption and emerging risks is also considered [2],Under FSS act, in 2008, separate authority named Food safety and standard authority of India (FSSAI) was constituted under ministry of health and family welfare to regulate the food business and food safety regulations. However, in 2011, FSSAI started functioning in accordance with the FSS Act, This FSSAI launched food licensing and registration system, where the platform for the food business operators to register their food products and business[3]. The primary objective of this article is to convey an overview of the food safety compliance system and to discuss the various chronological paths food business regulation in India. The secondary objective of the study is to compare the various aspects such as registration/ different licensing systems, fee structure, penalties of previous system with the existing one. The final objective is to provide specific details of the migration procedure from old registration system to current system and the renewal procedure for license.

Food Licensing and Registration System (FLRS)

FLRS is an online programme developed in 2012 by the FSSAI to let Food Business Operators (FBO) in India to apply for licences and follow their applications while they are processed. FBOs can apply for Licensing / Registration by registering online for a username and password (or) by giving contact information. FLRS allows FBOs to assess the eligibility of their premises based on the location or activity being undertaken on that premise. FLRS delivers automated alerts to FBOs through email and SMS at various intervals to assist speedier application processing and to ensure the continuity of their licenses/registration certificates[4]. FBOs should print the Online Application Form created by the system and send it to the Regional Authority/State Authority, along with all supporting documents, within fifteen days after the date of online submission of the State License and Registration Certificate application. All papers must be uploaded online in the case of a Delhi State License and Registration Certificate, as well as a Central License, and no physical documents must be provided to the Regional Office[5]. Though the system was simple **superficially**, but were associated with some challenges such as requisition process was time consuming, not user friendly, the technology on which it was built was outdated with technical support no longer available. Over time, customers grumbled about FLRS's poor performance, and software specialists rejected any FLRS revisions, limiting any further progress, growth, and innovation in the licencing system. The new FLRS system has been integrated with a mobile app and other information technology platforms. On the occasion of the launch of Food Safety Compliance System (FoSCoS), the FSSAI declared that any single regulatory mechanism at the pan-India level with an integrated response system ensures food fraud and provides an advanced risk-based and data-driven regulatory strategy[6].

Food Safety Compliance System (FoSCoS)

TheFoSCoS is an improved version of the FLRS, which was launched in 2012 to issuance of pan-India FSSAI Licenses and Registration. It has grown naturally and progressively in response to evolving regulatory requirements.

Objectives of FoSCoSis to create an integrated application that is technically advanced that can interoperate with other apps, handle more user traffic, and has the capacity to be upgraded and expanded in the future. To make conducting business easier among FBOs, improve user performance of the application and make the application process easier and more efficient. Minimize physical documents and streamline business processes for FBOs who want to apply online. Obtain and allow the application to have a consistent product strategy for manufacturers rather than a text box method [7].

Organizational structure of FSSAI

FSSAI organisational structure composed of a chairperson and 22 members, this consists of mainly two committees; scientific committee and advisory committee, the scientific committee is to regulate the food standards and the advisory committee is to regulate the food compliance and inspection. The scientific committee consists of 17 scientific panels among those each scientific panel is has a chairperson and 6 independent members. The advisory committee consists of central advisory committee, state level steering committee and district level advisory committee[8].

Services offered

The FSSAI's newly designed platform provides the following services to FBOs:

- Registration for Smaller Food Business Owners
- Restaurant License
- Proprietary Food License
- Renewal and Modification of a Food Manufacturing License
- Mid-Day Meal, E-Commerce, Airport, and Seaport Licensing
- License for the main office of a business
- Exporters and Importers Food product License
- License/Registration Endorsement of Fortified Food Products
- Exporter's Quarterly Return
- Respond to an Application That Has Been Rejected
- Approval of Organic Food Products
- Surrender of license
- Transfer of License[9].

Procedure for Obtaining FSSAI Registration Online

- FBOs can apply for FSSAI registration online by filling out Form A (Registration Application) or Form B (State and Central License Application) on the FoSCoS website and submitting it. FBOs can also register with the Department of Food and Safety by completing Form A or Form B.
- The FSSAI registration form must be accompanied by the necessary paperwork. During the application procedure, the documents must be submitted to the FoSCos site or physically given to the Food and Safety Department with the application.
- The Department can approve or reject the FSSAI registration form after 7 days of receiving it, either physically or online through the FoSCoS site. The applicant must be told in writing if his or her application is declined.
- The submitted documents will scrutinized by Department.
- If required, prior to awarding the FSSAI registration certificate, the Department may conduct an inspection of the food facility.
- If the Department finds that the FBO meets all of the requirements, it will issue an FSSAI registration certificate that includes the registration number and a snapshot of the applicant's email ID. The applicant can also obtain the FSSAI registration certificate by going to the FoSCoS portal.
- During business hours, the FSSAI registration certificate shall be conspicuously displayed at the FBO's location.
- licensed or registered FBO can view the details of their existing licenses/registration in the FLRS[10].

Migration procedure from FLRS to FoSCoS

Currently, The FBOs involved in the registration of food products/business have to apply through FoSCoS, but FBOs those who already registered in the old FLRS need to migrate from FLRS to FoSCoS for that FSSAI provided with the migrating procedure, the below chart having the step by step procedure for migration.

Manufacturing Kind of Business

Figure 4: Migration procedure for manufacturing kind of business

Non-Manufacturing Kind of Business

Figure 5: Migration procedure for non-manufacturing kind of business[12].

Types of FSSAI license

In order to operate a food business in India, one must first obtain a food licence. FSSAIs are classified into three types. These food business categories are determined by the nature and size, as well as annual turnover as well.

FSSAI Basic Registration Licence

Food industry operators such as petty food makers and small-sized manufacturers, storage facilities, transporters, merchants, marketers, wholesalers, and so on must get FSSAI registration. On the other hand, the State Government issues the FSSAI Registration. An FBO may fall under the State or Registration licence, depending on eligibility. As a result, it is primarily for businesses with yearly turnover of up to 12 lakhs, these FBOs shall get registered with Registration Form A. This licence has a maximum term of 5 years and a minimum tenure of 1 year.

FSSAI StateRegistration License

Small to medium-sized food industry operators, including as manufacturers, merchants, storage units, distributors, transporters, marketers, and so on, must get a Fssai State License. The State Government issues the State License, and FBOs must have activities in only one state. As a result, it is primarily for businesses with a yearly turnover of more than 12 lakh then the FBOs shall apply for State license Form B. This licence has a maximum term of 5 years and a minimum tenure of 1 year.

FSSAI CentralRegistration License

Importers, 100 percent export oriented units, big factories, operators in Central Government agencies, airports, and seaports, among others, are needed to get a Central Food License. The Central Government issues the Central licence. FBOs must also seek a Central License for their head office and if they have activities in more than one state. As a result, It is intended for one firm with a turnover of more than 20 crores per year, then the FBOs shall apply for Central License Form B. This licence has a maximum term of 5 years and a minimum tenure of 1 year[13].

Checklist for FSSAI registration requirements

Table 1: FSSAI Registration requirements checklist

Food Labelling Requirements

Every food product is sold through e-commerce or any other direct selling means needs to be provided with the minimal information about the food product as per the labelling regulation of FSSAI. The food label should contains the following information[15],

-Name of the food
-Ingredients list
-Nutritional Information
-Net quantity
-Lot/code/batch identification
-Manufacture or packing date
-Manufacturer Name and complete address

-Declaration regarding Vegetarian and Non-vegetarian
-Declaration Regarding Food Additives
-Best before and use by date
-Country of Origin (for imported food)
-Instruction for use[16].

Offences & penalty

Chapter IX of the food safety and standard act 2006 contain the general provisions for penalties for various offences/contravention of provisions of the act, rules & regulations committed by an individual. The table 2lists the kinds of offenses with their respective penalties under FSSA 2006.

Procedure for License renewal

Depending on the Food Operator's eligibility, Form A or Form B must be completed. These are the essential forms that must be filled out and include the Food Operator's business activities as well as a self-attested declaration that FBOs are required to comply with the Food Safety and Standard Act standards. A photo identity document, such as an Aadhar card, driving license, voter ID card, passport, or similar, is also mandatory**.** When the authorities receive application, they will analyse it and may arrange for an inspection at business premises to ensure that FBOs have disclosed all relevant information and that it has been submitted correctly. If they are satisfied with their business processes after a successful inspection, they will grant a licence in their favour. The licence should then be delivered to you within 60 days. If more than 60 days have passed and if licence is not-obtained restart the said procedure again without further notification. Within 30 days of the expiration of their present license, FBOs must apply for a license renewal. If the application for renewal of food license is not filed within this time limit, a penalty of Rs.100 will be charged for each day of lateness. As a result, if the registration of the food licence renewal of a licence is not applied for within the prescribed time, the licence is assumed to be expired[18].

CONCLUSION

Nutraceuticals and dietary supplements in India gaining much popularity and contributing significantly to the Indian economy. Implementation of Food Safety Standards Act, 2006 and Food Standard Regulations 2011 along with its recent amendments brought noticeable changes in the development novel products. The recent implemented platform along with the amendments bought the ease in the registration, licencing, migration, labelling and tracking process. Nevertheless, some of the process such as retailing programs, increased validation, manufacturing standards, clinical research and Intellectual property protection can be effectively adopted before the product enter into the market. In order to increase the standards and to meet global requirement, a common platform can be can be created which can connect various manufacturer, agencies including various policy makers and regulators periodically.

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Table 1: FSSAI Registration requirements checklis

sl.no	Requirements	Basic Registration	State license	Central license
1	**Application fee**	Rs.1499/- (Including 01 Year Govt. Fee)	Rs.2500/- (Excluding Govt. Fee)	Rs.3500/- (Excluding Govt. Fee)
2	**Eligibility**	Sales Up to 12 Lakhs	Sales from 12 Lakhs to 20 Crore	Sales above 20 Crore
3	**Documents**			
3.1	Authorized person address proof	✓	✓	✓
3.2	Passport size photo	✓		
3.3	Business name and address	✓		
3.4	Rental Agreement of Business Premises.		✓	✓
3.5	ID Proof of the business holder	✓	✓	✓
3.6	In case of any Government Registration Certificates		✓	

3.7	Partnership deed copy		✓	✓
3.8	Trade license/ Shop and Establishment Registration/ Municipality License		✓	
3.9	NOC			✓
3.10	copy of License from the manufacturer			✓
3.11	IE (import export) Code			✓
3.12	Nature of Business	✓	✓	
3.13	FSSAI declaration form	✓	✓	
3.14	Food safety management system plan			✓
3.15	List of food categories desired to be manufactured			✓

Table 2: Offenses and penalties under FSSA 2006[17].

Sl.No	Particulars	Fine
1	Food quality not in compliance with act	2 Lakh Petty manufacturer – 25,000/-
2	Sub-standard food	5 Lakh
3	Misbranded Food	3 Lakh
4	Misleading advertisement or false description	10 Lakh
5	Extraneous matter in food	1 Lakh
6	Failure to comply with Food safety officer direction	2 Lakh
7	Unhygienic processing or manufacture	1 Lakh

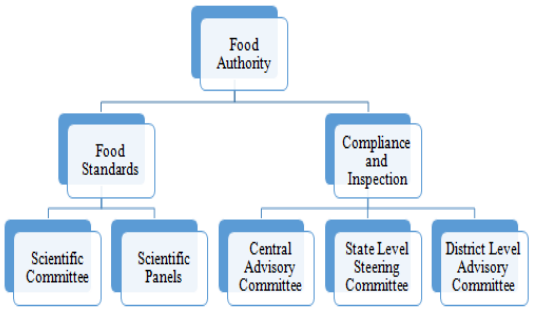

Figure 1: FSSAI Organizational structure

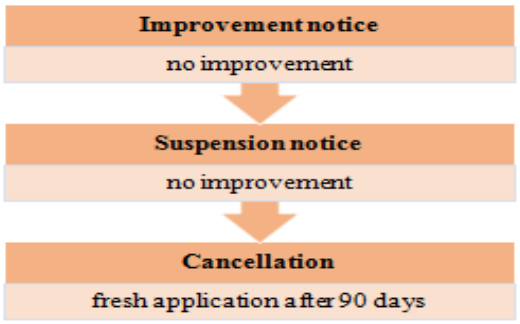

Figure 2: Kinds of notifications

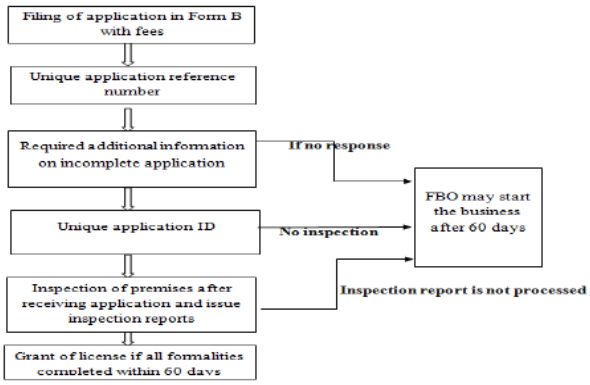

Figure 3: FSSAI registration procedure(11)

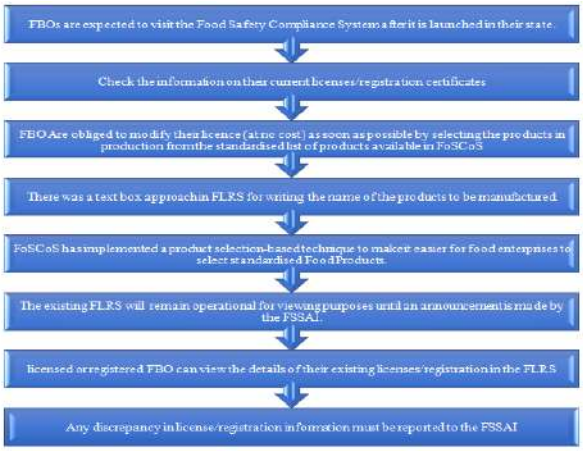

Figure 4: Migration procedure for manufacturing kind of business`

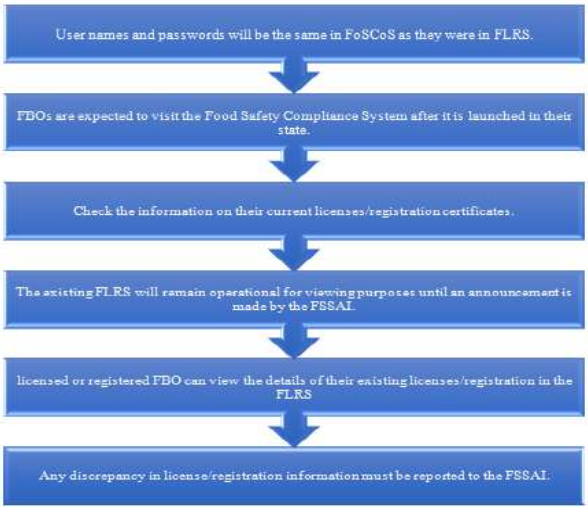

Figure 5: Migration procedure for non-manufacturing kind of business[12]

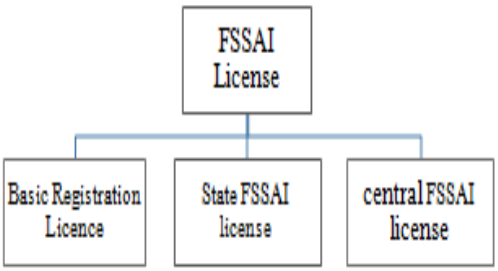

Figure 6: Different types of FSSAI registration licences

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RESEARCH ARTICLE

Modal Choice Determinants in an Urban Set up for the Daily Commute

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ABSTRACT

This paper aims to find out the factors affecting the mode of transport for the daily commuters of Guwahati city, the gateway to the north east India. Guwahati city has undergone the chronic urban sprawl in the last few decades which has made the traffic congestion a frequent phenomena in the streets. The vertical and horizontal spread of the urban areas have their own limitations. Policy makers often try to attract the commuters from the private to public transport to reduce the instances of traffic congestion and related externalities. Understanding the mode choice behaviour of the daily commuters is of utmost importance for the policy makers to achieve this objective. This study is based on a field survey. We interviewed a sample consisting of 400 commuters spread across the city; our model studied whether a public or a private transport shall be chosen by a daily commuter with the help of ten predictor variables income, cost, accessibility, travel time reliability, social status, pleasure of driving, road condtion , sex and age. Our results show that environmental concern, self-perceived social status of the commuters, pleasure of driving, travel time, sex and income are significant factors affecting the modal choice.

Keywords: Modal choice, Guwahati, Transport system, daily commute.

INTRODUCTION

Commuting is an economic activity, it involves monetary cost and affects the environment in terms of some negative externalities like air and noise pollution. While some commutes are done for recreational purpose, most of the daily commutes are mandatory to earn a living or are mandatory in nature; examples include going to office/business establishment, children going to school, delivery agents going for parcel delivery etc. Literature suggests that policy makers aim to make the public transport more popular among the city commuters in order to minimize the per capita emissions. In this context, understanding the factors affecting modal choice is of utmost relevance for the policy makers so that proper policies can be devised to transfer the commuters from the private to the public

transport. In India there are unions of the public transport service providers such as Auto-rickshaw associations, City bus associations at city and state levels who with their collective bargaining power are often able to get their demand fulfilled from the government but the there is no such commuters' associations. This makes it difficult for the policy makers to understand the preference of the commuters in public transport and the objective of transferring the private transport users to the public transport remains unfulfilled. The classic case of failure of Mumbai mono rail project[1] is noteworthy in this case. The lack of unionization of the urban commuters makes it difficult for the researchers to understand the factors affecting their modal choice. This makes it necessary to understand the factors affecting modal choice at local level. The idea of smart cities shall remain a failure if transportation needs of the people are not studied seriously. Commuting can be broadly classified as active commuting and passive commuting. Active commuting requires use of considerable amount of physical energy of a commuter such as walking and cycling but passive commuting does not demand physical energy up to a great extent. Passive commuting can further be classified as private transport and public transport. These transport systems are mostly based on internal combustion engine and diesel causing air pollution. In case of private transport, the ownership of the vehicle remains with the individual while in case of the public transport, the vehicle ownership is in the hand of the either government or private bodies but the commuters are not the owners.

Some public transport such as city bus,e-rickshaws, trains, metro rail etc. have fixed routes while the others like bike taxi, cabs, auto-rickshaws are not route specific. The strategic location of Guwahati, often called the gateway to the north east India attracts huge number of people from the neighbouring districts and states of Assam. Not only the migration to the city , the natural rate of growth of the city is also responsible for the demand for an improved transport system. The private transport includes bicycles, two wheelers like scooters and motorcycles, cars of all types and the public transport has options like the city bus service, shared vehicles (popularly, magic service),e-rickshaws bike taxis, auto-rickshaws, cabs in increasing order of affordability. City bus service is available on the designated routes of the arterial roads, magics too have designated routes but they ply on both the arterial and sub arterial routes both of them are characterized by stop making behaviour. E-rickshaws ply on sub arterial routes covering the needs of very short distance commuters. Auto-rickshaws can be hired to reach to a specific destination with higher fare or they ply on the designated routes with many passengers on board and compete with e-rickshaws. For hired auto-rickshaws there is no fixed routes and no stop making unless desired by the passengers. Cabs and bike taxis offer service in the entire city with no stop making behaviour (Unless demanded by the commuter). The existing transport studies of Guwahati focuses on the air and noise pollution due to traffic, studies on the improvement of road design based on GIS technology and some highlight the traffic congestion prone areas .Air and Noise pollution due to road traffic are studied by [2-3] Road design to facilitate uninterrupted traffic flow in Guwahati is studied by[4], studies on road infrastructure and traffic flow system to achieve the target of sustainable urban infrastructure is performed by [5] effectiveness of the Para-transit Service in Guwahati is studied by [6] study on placement of charging stations in different locations of the city are is performed by[7] but to the best of our knowledge there is no study to explore the factors affecting modal choice in Guwahati city. The present study fulfills this gap of literature.

REVIEW OF LITERATURE

Choice of mode of transport is affected by many factors. Studies concerning factors affecting modal choice vary in terms of methods, data, explanatory variables, units, geographical regions. The factors affecting modal choice can be broadly classified as economic factors such as fare [8], Income [9],and psychological factors such as intention and habit [10], attitude[11],pleasure of driving [12-15],anxiety [16]spatial factors such as land use [17] accessibility [18-21] other demographic factors such as age [22] sex, religious practice of veiling [23]. Besides based on the situational factors like urgency of travel, weather conditions, road condition, number of co passengers, the mode of travelling may change, breaking the habit of choosing the same mode of transport for the daily commute. The presence and absence of traffic congestion and availability of parking space affects the modal choice in an urban set up particularly in thickly populated area [24]. Many of the psychological factors affecting the modal choice studies are based on

different versions of the Theory of Planned Behaviour(TPB). Some scholars like [25]have argued that the psychological factors of modal choice are more prominent than other types of factors. We can argue that economic factors determine the effective demand for any mode of transport and the economic factors shape the psychological factors such as habit. Age of the commuter is an important factor affecting his/her mode of transport, for example, for school children it is the decision of the parents and the school authority which determines their mode of transport and [26] has found that that with increasing age, the mobility declines but preference for private transport goes up. In countries with extreme temperature especially during the winter season, people prefer to use the public transport more than active transport such as cycling or walking[27]. Literature has provided some socio economic factors affecting the modal choice of the respondents. For eg. Travel time reliability [18,28-32]; Fare[21,30,32] Accessibility [18-21] Environmental concern [22,33-34], Social position of the commuter [35],Pleasure of Driving [12-15]. We define travel time reliability as the adherence to schedule, Fare/Cost is the cost of travelling for daily commute. Accessibility is defined as the ease of reaching the destination with a particular mode of transport. Environmental concern is reflected by the choice of the commuter of an electric vehicle over a traditional internal combustion engine based mode of transport. Traffic congestion is omnipresent in the cities of the developed as well as developing world.

The studies on traffic characteristics and traffic congestion in North East India are very thin. Most of the studies available in the public domain are Guwahati and Shillong specific. The remaining cities of the states are not covered by literature available in the public domain as of now. The economic aspects of traffic congestion are least explored by the existing literature in this part of the world. In Shillong, Meghalaya traffic congestion is responsible to rise in the fuel cost from 45.73 per cent to 134 per cent on different locations of the city [36].Due to traffic congestion the average travel time has gone up from 36.33 per cent to 323. 60 per cent in different areas of the city. Studies like [12,37-38] have focused on the choices of transport mode which shows the continuously growing interest of the researchers to this aspect of transportation. However, their methodologies are different from each other. Some researchers focused on the socio economic factors while others focused on the psychological factors. Besides this, there can not be any uniform set of psychological factors affecting the mode choice of the people in every city of the globe. Had this been the situation the same vehicle could have been equally popular across the world. We have witnessed that while General Motors and Ford Motors are well known brands in the United States of America but both could not gain a sizeable market share in India and had to close down their manufacturing plants in India after being in the business for a considerably long period of time. On the contrary, Suzuki is the leader of private vehicle sales in India but had to quite the North American market [39]. The review of the existing literature reflects that there is still a need to find out the factors affecting mode choice at local level.To understand the preference of the commuters the correct process shall be to study the same at city level. The local needs and preferences should be highlighted while making any policy regarding public transport.

METHODOLOGY

Study Area

The present study area encompasses the city of Guwahati . The city is often considered as the gateway to the north east India and attracts tourists, students, medical patients, job seekers, migrant labours from all the 35 districts of Assam as well neighbouring states. With the population of 11.2 lakh as per the census 2011, Guwahati is the largest city of Assam. Our focus is on road users only because the remaining modes of transport are not much used for the intra city travel purpose by most of the people. Road trips are most widely used for moving within the study area. A cursory look at the road maps of the city (Map 1) reveals that unlike the planned cities like Chandigarh, India the roads of Guwahati are not planned by any central planning authority before. Such kind of cobweb roads are susceptible to more traffic jam if the traffic management is not proper. The unplanned growth of the city [40]coupled with the increasing number of vehicles causing frequent traffic congestion for the commuters. The number of vehicles are increasing in the city due to increased income of the city dwellers while public transports consists of the city bus, share taxi (magic service),auto rickshaw, e-rickshaw, cabs like Ola, Uber, Peindia, and bike taxis of such brands.

Data collection and sampling procedure

To select the sample size we used the Taro-Yamane formula of sampling as under

$n=N/(1+Ne^2)$

Where n is the sample size, N is the size of the population, e is the margin of error which is taken at 5 per cent. Using this formula, the our sample size stands at 400. The data were collected randomly from the four broad areas of the city to ensure heterogeneity and include commuters from all the sections of the society. The commuters of the city are divided into four legislative assembly constituencies(LACs) based on their residence viz East Guwahati, West Guwahati, Dispur and Jalukbari and responses were collected with the help of a self structured questionnaire with 100 respondents from each of the LACs. To collect the data we reviewed the available standard questionnaire like" Transport Survey Questionnaire", University of Sussex, 2021;School Travel Questionnaire, 2020; Transportation Survey For Employees, 2013.These questionnaires shed light on the factors affecting mode choice and to suit the local needs an Anglo Assamese questionnaire was prepared. We went for a pilot survey with 15 respondents to understand whether the they were finding it difficult to understand the questions; based on their inputs we made certain changes to make the questionnaire easy to comprehend. The data were collected on random basis from forty different locations of the city. We further divided the areas into three groups such as traditional area, commercial area and newly established areas. Traditional areas are mostly residential areas with settlements of more than 100 years ago. Commercial areas are the hub of retail and whole sale areas, transport and logistic facilities with hotels ,educational instituties as well as administrative offices. Newly established areas refer to the areas where settlements begin mainly in the last two decades or so [41-42].The residence profile of the respondents are presented in Table 1.

METHOD

Initially a descriptive approach was taken to describe the transport system usage pattern by the daily commuters. Percentage analysis and simple correlation analysis was performed to throw more light into the subject.A binary logit model is an extension of simple linear regression model. Here, the dependent variable is a dichotomous or binary variable and the predictor variables (or independent variables) may be both continuous or categorical. Our paper is based on the idea of Random Utility Theorem. This theorem states that choice of individuals is based on the utility that they derive. Random variables affect their mode of transport. A discrete choice model is based on the theory that the probability of choosing a given alternative is a function of the socio-ecomic characteristics of the respondents and the relative attractiveness of the option[43]. Binary logistic regression model is a type of discrete choice model that is widely used in econometrics. To find out the factors affecting the modal choice in the for the daily commute we used the binary logistic regression model. The odds of choosing a public transport over the private transport was found with the help of eleven predictor variables which are socio-economic, spatial and psychological in character. In the neoclassical framework economists assume the absolute human rationality, so that rationality of humans maximize the benefits and minimizes the costs for the subject. In fact, it is assumed that a rational consumer will choose that combination of commodities and services which is most useful for him/her. However, literature shows that psychological variables, spatial as well as demographic affect the transportation mode choice too, so we included socioeconomic, psychological and spatial and demographic variables in our analysis. The random utility theory says that people choose what they prefer. The alternatives that are not chosen are due to random factors. 'Random factors' here mean that the variations in the human behaviour are not explainable. The theory has a drawback of assuming absolute rationality of humans but still its not totally rejected and is used widely. The random utility model provides an interpretation of the individual choices [44]. Let us assume that the i^{th} individual's decision to choose public transport or not depends on an unobservable utility index R_i^* which is a function of the predictor variable.

$$R_i^* = AX + v_i \quad (1)$$

Where X is the column vector for the predictor variables and v_i is the residual term. Since utility is unobservable and has to satisfy the following two constraints.

Y_i= 1 if $R_i^*>0$
Y_i=0 if $R_i^* \leq 0$

In equation (1) AX is the non stochastic systematic utility. The residual term encompasses the errors of measurement and the random utility due to unobserved variability. We assume that the distribution of the residual term is independent and identically distributed. To make the concept more operational let us assume that a commuter chooses a public transport that is y=1

$$Pr(y=1) = Pr(R_i^* \geq 0)$$
$$= Pr((AX+v_i \geq 0))$$
$$= Pr(v_i \geq AX) \quad (2)$$

This probability depends on the probability distribution of y which in turn depends on the probability distribution of the residual term v_i,.Equation (2) can be rewritten as

$$Pr\ (v_i \geq AX) = Pr(v_i \leq AX)$$

Therefore, $Pi = Pr(y=1) = Pr(v_i \leq AX)$

A bivariate logistic regression models the above mentioned decision making. The residual term v_i follows the probability distribution function thus

$$p = \frac{1}{1+e^{-x_i}} \quad (3)$$

Here p is the probability of choosing a public transport mode of transport and

$X_i = ax+v_i$

when y=0, the probability of non-usage is

$$1-p = \frac{1}{1+e^{x_i}} \quad (4)$$

Dividing equation 3 by 4 we have

$$\frac{p}{1-p} = AX \quad (5)$$

Here $\frac{p}{1-p}$ is called the odds ratio in favour of choosing a public transport.Taking the natural log of the equation (5) we have

$$\ln\left(\frac{p}{1-p}\right) = ax+u_i$$

Since the odds ratios are non linear and logit link function makes it linear in both parameters and explanatory variables by using the the maximum likelihood estimation method is SPSS we use the parameters are estimated.

Variables

Eleven predictor variables (Table 2) were taken into account to explain the likelihood of using a public transport usage by a commuter in Guwahati city.

RESULTS AND DISCUSSIONS

A descriptive analysis of the variables was first conducted to understand the modal choice behaviour of the commuters. It included the socio-economic and demographic profiling of the commuters, mode of travel used by the commuters across various categories and then we ran a logistic regression to find out the factors affecting the mode choice behaviour of the commuters. Our dependent variable, "Mode of Transport" was a dichotomous variable, with the response options of Private vehicles and Public vehicles. Majority (67.5 per cent) of the respondents of our survey are young and in the age group of 17-30 years (Table 3). This is an encouraging result as the work related daily mobility of the old aged person is less than the middle aged people (Gera, S., & Paproski, D.,1980).The distribution of income of the commuters show that our study encompasses data from all the sections of the society. The preference for a private vehicle as a means of commuting increases with age. With increasing age, till 44 years the usage for private vehicle goes up steadily and it falls in the age group of 45-55 years and again increases for 55 years or more aged person (Table 4). We coded the responses of choosing a private vehicle as 0 and public transport as 1 and ran the point biserial correlation in Microsoft Excel 2019. The point biserial correlation between the variable "mode of transport" and: "age" is (taken as a continuous variable) found to be -0.2. It implies that if the variable "mode of transport" takes value 1(public transport) then the variable "age" tends to take lower values compared to when the variable "mode of transport" takes the value 0(private transport). The preference for comfort could be the dominating factor for choosing lesser and lesser public transport with the ageing of the respondents. The highest used means of transport by commuters in Guwahati is city bus (Table 4). Personal four wheeler is the second highest mode of transport of our respondents followed by carpooling/ola/uber/share auto-rickshaw/magic. Own two wheelers are the fourth popular means of transport. Our data revealed that many people own more than one personal vehicles. Based on the need for transport they switch from one type of mode of transport to another. Walking is the least preferred mode of transport for the daily commute and is mainly used to cover short distances. Currently, the city has only two dedicated bicycle tracks of which one at Sonaighuli area popularly known as Dakhingaon-Sawkuchi cycle track and another at the Jayanagar area with a length of just 100 meters. The insecurity on the main road and absence of dedicated cycle tracks across the city could be the possible reasons for non popularity of the bicycles.

Our result shows that keeping all other variables constant the odds for choosing a public transport over a private transport increases for the city area with an increase in the environmental concern and for a female commuter but the same falls with an increase in social status of the commuter, pleasure of driving and travel time.To be more specific an increase in the environmental concern by one unit, the public transport usage increases by 1.197 times or (19.7%). Our result is similar to [15] who found that environmental concern affects the mode choice behaviour of the commuters and people with more environmental concern perceive the public transport more easier, more useful and more pleasurable. People attach symbolic values to their vehicles. A vehicle is a status symbol for many [12] leading to symbolic motive of private vehicle usage. This may act as deterrent to shift to the public transport usage for the private vehicle users. This is reflected in our finding as well. The odds of using the public transport decreases by .823 times (17.7 percent) with one unit increment in the "my social status" of the commuter (Table 5). In our context my social status is the variable reflecting the symbolic value of vehicle usage. Studies like [14,43-44] have found similar results showing how an increase in the symbolic value of the car favors the increased usage of the private vehicle usage.

Driving a vehicle is a source of pleasure for many [45-47]. This pleasure is absent for a commuter if he chooses a public transport as currently the public transport in Guwahati offers very limited scope of self-driving. Besides such options are generally availed by the commuters to go long distance. So to find whether pleasure of driving is a

significant factor affecting the mode choice our model point out that that the odds of choosing a public transport falls with an increase in the pleasure of driving. A one unit increase in the pleasure of driving a vehicle decreases the odds of choosing the public transport by .747 times. (or by 25.3 percent) . The travel time is a factor affecting the modal choice of the commuters. Often the commuters with short travel-distance gets themselves adjusted with uncomfortable journey in public transport, while the long distance commutes are generally preferred with comfort in mind. Our results show that city commuters with more travel time don't prefer a public transport. The odds of choosing a public transport falls by .562 units (43.8 percent) for every extra kilometers travelled.

Existing literature studies the rural-urban migration of women along with their husband [52], job training and mobility of women [53], inter-generational mobility of females and education level attained [52] however, the literature discussing women mobility in an urban set up are are rather limited.[23]has argued that urban mobility of women is affected by the power structure in the society, religious practice of veiling etc. We focused on the question if sex a significant factor in choosing a mode of transport? The odds of choosing a public transport for a female is 2.215 times more than that of her male counterpart(Table 5).One of the possible reasons explaining this behaviour is that many women are still financially dependent on the male members of the family and hence affording a private vehicle for majority of them is a distant dream. Literature evidence support our finding ,[53] has found that women are more environment-friendly than men but they reject active driving. This reflects light on why women prefer public transport more than men as the options of public transport in Guwahati don't offer the same . Income is found to be a significant factor affecting modal choice of the commuters but its exp(B) value as 1.It implies that with one unit increment income of the commuter the likelihood of choosing a public transport or a private transport is equally likely. Unlike the popular belief that rich people like to commute in public transport in Guwahati such kind of behaviour of the commuters highlights the problems of present traffic infrastructure. One of our female respondents said that she and her husband both has cars but when she has to send her son to tuition classes, she uses Ola cab service to avoid the problem of scarcity of parking space in ABC area of the city. The predicate variables like cost, accessibility, travel time reliability, road condition, age are not found to be statistically insignificant in our analysis. Female commuters are more dissatisfied (50.2 per cent) with the existing public transport system than their male counterparts (49.7 per cent)(Table 6). Policy makers tried to address this issue by providing free bus services for the females and aged passengers inside the city(popularly known as the Pink bus service) but the limited number of pink buses that too plying on only a few selected routes are yet to make the targeted commuters satisfied apart from that the state government provides scooters to the female students higher secondary class who have scored first division in their exams. In the past, we saw the emergence of Megha radio cab service all operated by female drivers but due to losses in the business, it had to close down. There is a need to understand the expectations of the female commuters to provide better public transport facilities to them. Daily commuting is a need for all the city dwellers.

Introduction of various modes of private and public transport in a city has got economic, environmental, psychological consequences. It is evident from the findings of our study that environmental concern, self-perceived social status of the commuter, pleasure of driving, travel time and sex are significant factors affecting the mode choice in Guwahati city. A commuter with more environmental concern is likely to adopt the public transport. Contrary to this commuters with high self-perceived social status of themselves are likely to use private vehicles. For them a car is a status symbol and not mere means of commuting to the workplace. Thus usage of public transport appears to be a positive function of the environmental concern but negatively associated with the social status. Besides people who derive pleasure from driving a vehicle are less likely to adopt public transport and more travel time is a discouraging factor for switching to public transport. The likelihood of a female commuter adopting a public transport is more than her male counterpart. The statistically insignificant factors like income ,cost, accessibility and travel time reliability are found to have the expected sign on their coefficients. It is interesting to know that while more females are dissatisfied with the public transport yet our analysis finds that the odds of choosing a public transport for a female commuter is more than that of her male counterpart. This could be possible because of the skewed distribution of income in favour of the males. With less financial freedom combined with the fear of active driving are the possible reasons for more preference for public transport on the part of females.

We conclude that policy measures target the male commuters to use public transport more. While the present policies focus on female commuters only for example in Guwahati there is Pink bus service, where the female commuters and senior citizens can move freely from origin to their destination. Environmental awareness should be promoted more to reduce the effect of symbolic motive of car usage because while the former encourages usage of public transport while the later promotes the usage of private transport. The vehicle companies should start marketing their e-vehicle aggressively to make them look like premium cars, a status symbol for rapid expansion of the electric vehicles and the ongoing subsidy programs on the electric vehicles should continue with rapid expansion of electric vehicle infrastructure such as charging stations or enhanced battery swapping facility. Increased travel time is a discouraging factor for switching to public transport. Along with traffic congestion illegal stop making behaviour particularly of the larger public transport such as city bus is a frustrating experience for the commuters. Traffic issues in Guwahati is more a management issue than infrastructure needs. The passive monitoring of the vehicles like providing whats app no of traffic police authorities for providing evidence of traffic law breaking wont work much unless the commuters are educated and really concerned about traffic problems. Deployment of traffic personnel at every bus stop is the need of the hour to look for stop making beyond the permissible limit and improve the quality of service of the public transport.

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Table 1.Classification of the respondents based on their location of residence

Legislative assembly councils	Category	No. of respondents
Dispur	Traditional area	21
	Commercial area	29
	Newly Established area	50
Jalukbari	Traditional area	36
	Commercial area	41
	Newly Established area	23
Guwahati East	Traditional area	35
	Commercial area	39
	Newly Established area	26
Guwahati West	Traditional area	43
	Commercial area	38
	Newly Established area	19

Source: Authors' calculation from primary data

Table 2:Description of variables included in the analysis

Variables	Type	Description	Expected sign
Mode of travel	Binary choice/nominal data	Public transport or Private transport	N/A
Cost	Ordinal likert scale data	Cost/fare as a determinant of modal choice	-
Accessibility	Ordinal likert scale data	Accessibility as a determinant of modal choice	+
Environmental concern	Ordinal likert scale data	Environmental concern affecting the modal choice	+
Pleasure of driving	Ordinal likert scale data	Pleasure of driving as a determinant of modal choice	-
Road condition	Ordinal likert scale data	Road condition as a determinant of modal choice	-
Travel time	Binary choice nominal data	Travel time determines the mode of transport (Yes=1,No=0)	-
Sex	Binary choice /nominal data	Male=1, Female=2	+,-
Age	Continuous	Age of the resplendent	-
My social position	Ordinal likert scale data	Perceived social positron of the self measured on a scale of 1-5 in likert scale of acceptability	-

Source: Authors' preparation from field data

Table 3: Socio economic and demographic profile of the commuters:

Category	Groups	Per cent
Age	17-30 years	67.5
	30-50 years	25.0
	50 years and above	7.5
Income (in INR)	0-10000	19.2
	10,001-20000	24.5
	20,001-30,000	18.2
	30,001-40,000	9.2
	40,001 and more	28.8
Occupation	Students and job seeker	37.2
	Business/Self employed	23.5
	Private	24.0
	Govt.	15.2

Source: Author's calculation from field data.

Table 4: Mode of travel used by city dwellers

Variables	Categories		Choice of mode of transport (in percentage)	
			Private	Public
Age range (years)	17-25		34.1	65.9
	25-34		41.5	58.5
	35-44		65.3	34.7
	45-55		46.2	53.8
	More than 55		66.7	33.3
Sex	Male		51.8	48.2
	Female		33.2	66.8
Monthly income	Less than Rs.50,000		36.4	63.6
	More than Rs. 50,000		68.6	31.4
Mode of transport	Nature	Vehicle	Percentage of user	
	Public Transport	City Bus	42.9	
		Car pooling/cab/share auto/magic	11.0	
		Bike taxi	4.0	
		Reserved autorickshaw (solo)	1.8	
		Official vehicle	1.3	
	Private Transport	Personal four wheelers (solo)	26.8	
		Own two wheeler(engine/motorised)	9.3	
		Bicycle	2.5	
		Walking	0.5	

Source: Authors' calculation from field survey

Table 5: Factors affecting the modal choice

Variables	**Coeffients**	Sig.	Exp(B)
Income	.000	.000**	1.000
Cost	-.004	.973	.996
Accessibility	.044	.739	1.045
TTR	.077	.474	1.080
Environemtal concern	.180	.049*	1.197
My social status	-.195	.033*	.823
Pleasure of driving	-.292	.005**	.747
Road_condition	-.083	.426	.920
Travel Time	-.575	.017*	.562
sex	.754	.001**	2.125
Age	-.014	.218	.986
Constant	1.943	.064	6.981

Source: Authors' calculation from the field data

*significant at 5 percent

** significant at 1 percent level of significance

Table 6: Overall Satisfaction with the public transport system

Overall Satisfaction with the public transport system						
Male		**Very Dissatisfied**	**Dissatisfied**	**Neutral**	**Satisfied**	**Very Satisfied**
Sex	Female	11.2	39.0	18.5	24.4	6.8
	Male	9.2	40.5	13.3	29.7	7.2

Source: Authors' calculation from field data

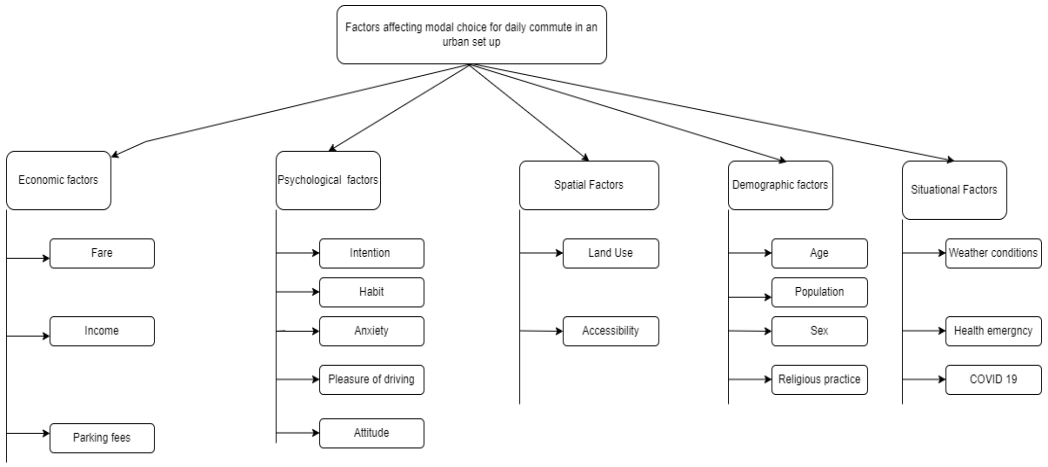
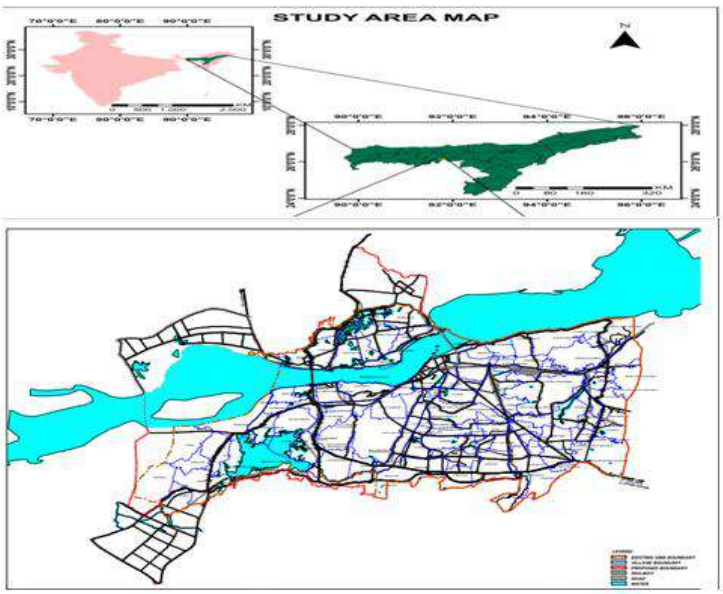


Figure 1: Factors affecting modal choice for daily commute in an urban set up.
Source: Prepared by authors' from literature survey.



Map1: The study area
Source: the Guwahati master development plan 2025.

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RESEARCH ARTICLE

Discovery and Detection of Fruits and Vegetables Spoilage using Computer Vision

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ABSTRACT

Computer vision and picture handling procedures have been seen as progressively valuable in the natural product industry, particularly for applications in quality location. Research in this space shows the practicality of utilizing PC vision frameworks to further develop item quality. It is troublesome in industry to characterize the nature of organic products utilizing conventional strategy so the picture handling procedure was acquainted with group the natural products. This undertaking presents the Computer Vision based innovation for natural product quality discovery. PC vision frameworks give quick, financial, sterile, predictable and objective evaluation. One of the significant quality highlights of organic products is its appearance. Appearance not just impacts their reasonable worth, the inclinations and the decision of the customer, yet in addition their inside quality somewhat. Various sorts of leafy foods are delivered in India. India is at second number after China underway natural product. It is troublesome in industry to arrange the nature of organic products utilizing customary strategy so the picture handling procedure was acquainted with order the organic products. Indian economy in light of agribusiness, so mechanization of farming and horticulture related industry assumes significant part. The designated recipients from this task incorporate ranchers, Indian specifically, who can't manage the cost of cost of the present natural product handling offices. One of the significant quality elements of organic products is its appearance.

Keywords: Computer vision, agribusiness, horticulture.

INTRODUCTION

Computer vision and picture handling methods have been seen as progressively valuable in the natural product industry, particularly for applications in quality recognition. Research in this space shows the plausibility of utilizing PC vision frameworks to further develop item quality. India is a horticulture country. Various kinds of leafy foods are created in India. India is at second number after China underway natural product. It is troublesome in industry to order the nature of organic products utilizing customary strategy so the picture handling method was acquainted with arrange the natural products. Indian economy in view of agribusiness, so mechanization of horticulture and farming related industry assumes significant part. This task presents the Computer Vision based innovation for natural.

EXISTING SYSTEM

Post-gather interaction of natural products is finished in a few stages: washing, arranging, evaluating, pressing, stockpiling and moving. One of the significant quality elements of natural products is its appearance. Appearance not just impacts their fairly estimated worth, the inclinations and the decision of the purchaser, yet in addition their interior quality somewhat. To satisfy the buyer's craving and financial necessity, organic product quality assessment turns out to be vital now daily. Nature of produce envelops tactile properties (appearance, surface, taste and fragrance), nutritive qualities, substance constituents, mechanical properties, practical properties and deformities. Every one of the organic products have restricted time span of usability during which it goes through underlying and compound changes. So, knowing the nature of organic products during timeframe of realistic usability is significant. Bio-movement alludes to the fundamental action of the natural example. The bioactivity of the organic products changes during their timeframe of realistic usability and it is likewise impacted by the climatic circumstances. product quality recognition. Utilization of this innovation is expanding in farming and natural product industry. PC vision frameworks give quick, monetary, clean, reliable and objective appraisal. One of the significant quality highlights of natural products is its appearance. Appearance not just impacts their reasonable worth, the inclinations and the decision of the shopper, yet additionally their inner quality partially. India is a horticulture country. Various kinds of leafy foods are created in India. India is at second number after china underway natural product. It is troublesome in industry to order the nature of organic products utilizing customary strategy so the picture handling method was acquainted with arrange the natural products. Indian economy in light of farming, so mechanization of agribusiness and horticulture related industry assumes significant part. Post-reap interaction of natural products is finished in a few stages: washing, arranging, reviewing, pressing, stockpiling and moving. Horticulturally effective nations like Israel and Australia have showed dynamic utilization of this advanced innovation and it should be vaccinated to Indian Fruit Industry. The designated recipients from this undertaking incorporate ranchers, Indian specifically, who can't bear the cost of cost of the present natural product handling offices. One of the significant quality elements of natural products is its appearance. Appearance not just impacts their reasonable worth, the inclinations and the decision of the customer, yet in addition their inward quality partially.

Disadvantages

- Indian specifically, we can't manage the cost of cost of the present organic product handling offices.
- Its actual appearance influences its worth on the lookout, so noticing appropriate treatment of organic products subsequent to harvesting is significant.

Proposed System

Texture, Color and Size are the significant boundaries for natural product quality distinguishing proof. PC vision and picture handling strategies have been seen as progressively valuable in the natural product industry, particularly for applications in quality location. Research in this space shows the plausibility of utilizing PC vision frameworks to further develop item quality. The utilization of PC vision for the examination of organic products has expanded during late years. The market continually requires greater items and thusly, extra elements have been

created to upgrade PC vision review frameworks. PC application in farming and food ventures has been applied in the space of examination of new items. It shows whether the natural product is fortunate or unfortunate in light of the nature of the natural product. Robotization is assuming significant part in everyday life. In India more than half population relies on horticulture. Their primary type of revenue is horticulture. Sending out of new organic product is expanded every day from India. Individuals are exceptionally cognizant about their wellbeing; they favor just new, great quality natural product. Surface, Color and Size are the significant boundaries for organic product quality ID. The variety acknowledgment is vital interaction in readiness location. The readiness identification is outside quality variable. Yet, surface is likewise vital. Due to surface abandoned natural product can be perceived. Surface examination recognizes the non-consistency of natural product external surface. The size is additionally significant boundary. It plainly seen boundary all client selects organic product in light of size. In this task the elements required are variety, surface and size. To finish accurate component preprocessing is on gained picture. The primary point of picture handling is an improvement of picture so undesirable bends are smothered and upgrade picture highlights which are significant for additional handling.

Advantages of Proposed System

- It is easy to identify the quality of the fruits.
- To replace manual inspection of food, computer vision system is used which provide authentic, equitable.

RELATED WORK

Acquiring the images of the Fruits

In this paper, we gathered the quantity of data set of organic product pictures that is great and terrible quality pictures. These natural product picture information bases are useful for more precise outcome.

Detection Process

RGB picture is changed over completely to HSV variety space. Then lower and upper reaches are characterized. Then scopes of twofold picture are characterized. Then convert single channel veil once again into 3 channels. For extricates a hued object to recognize red, here we use HSV tone thresh older content to decide the lower/upper limits. HSV variety space is additionally give the data about the picture that is, it either present or not in this framework.

Detection of defective Fruits

Figuring out the inadequate tomato is one of the most significant pre-handling steps. A variety picture of the tomato was utilized for the investigation. In the event that the pixel esteem is not exactly the chosen limit esteem, it is considered as a piece of faulty skin for example awful quality organic product. Any pixel esteem more prominent than the chose edge esteem is a piece of unadulterated skin for example great quality natural product.

System Architecture

The above figure shows System Architecture

CONCLUSIONS

Parcel analysis has been displayed as a methodology that works on the cutting edge by producing bundle channels that consolidate a large portion of the ideal properties as far as handling speed, memory utilization, adaptability and straightforwardness in indicating convention organizes and separating rules, compelling channel synthesis, and low run-time upward for wellbeing authorization. The advancement of the channel generator and the experimental outcomes support the practicality of our cases. We have planned, prototyped, and assessed SPAF, a parcel.

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Fig: 1 The above figure shows System Architecture

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RESEARCH ARTICLE

Driver Drowsiness Alerting System

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ABSTRACT

The growth of research and inventions in preventing road accidents has led to the development of many driver inattention monitoring systems. Some of the companies have adopted and implemented several techniques but lack the efficiency in providing the expected results. As a part of driver drowsiness detection, this paper deals with the efficient method of preventing accidents. The prevention and the control of the road accidents are possible with the help of the Smart sensing spectacles which can sense the frequency of the eye blinking and predict the drowsiness by comparing with the threshold value fed before. If the number of blinks crosses the threshold value, it gives the notification to the vibrator, which is arranged on the spectacles and alerts the driver. This notification is also sent to the mobile by Bluetooth protocol, so the mobile produces odd loud sounds to gain the attention of the driver. If the driver is unable to take control after the vibrator gives the response, this alarming sound system can be useful to alert the driver and prevent the cause of any sort of destruction. This smart sensing spectacle material is of with slim and sleek design that adds comfort and ensure driver to have a safe and proper journey.

Keywords: Smart Sensing Spectacles, Drowsiness, Vibrator, Bluetooth protocol.

INTRODUCTION

Imagine a situation that a person is going on a car for a longer distance. Suppose if the person is driving for a long-time, then the person may feel sleepy and start closing his eyes. Drowsiness may lead to an accident that causes the loss of property, loss of life, loss of money, etc. [1]. An article addressed by DC newspaper in the middle of 2018. They quoted that 2/3rd of the accidents in motorcycles and four-wheelers are due to lack of attention or due to drowsiness or sleep of the driver [2]. Moreover, the drivers in the car fall asleep due to various factors and lead to the

cause of many accidents. Many surveys show that major accidents are caused due to the sleep of the driver [3]. The technological advancements must often provide some solution to overcome the problem and ensure safe and secure driving [4]. Around 1.3 billion people dead and 20 to 30 million people are bedridden due to road accidents based on the data in [5]. Out of these accidents around one-fourth are due to the drowsiness[7]. The survey reports give us a real picture of the accidents due to the drowsiness of the driver. Many survey reports on accidents caused due to drowsiness of driver are due to the factors like the observation of the driver behaviour that include yawning, [8] the closing of the eye, head movement and vehicle movement based include deviation in the lane position, overpressure on the acceleration pedal, etc. The rate of death due to the accidents caused on the highways is very much high as mentioned by the road safety statistics. Many solutions based on the sensors have been published in the market related to driver sleep, causing incidents [9]. Maintenance of the system relative to the frequency of the eye blinking on the threshold value is an essential factor for detecting driver drowsiness. Many algorithms of the existing type have evaluated based on collected data from any of these three measures-Vehicle Based, Behavioural Based, and Physiological measures as researched by the ArunSahayadhas [10]. The present system was built by using the Raspberry Pi 3 is embedded in the car in such a way that image detection is shown using the screen that displays the drowsy state of the driver and alert is done by ringing the alarms in the vehicle. But the exposure of drowsiness by the usage of the camera by image processing does not give excellent accuracy and costly as identified by Alexis Arcaya-Jordan et al. [11].In the present system, eye movement is continuously observed by using image processing for continuous detection of the eyes of the driver. The decrease in efficiency of detection is low if continuous detection is not done as identified by Ratna Kaavya M et al. [12]. So, the developed system will overcome the disadvantages of the existed system and with multiple different features. This proposed method has not been implemented due to less efficiency, and the inaccurate results during the trails with this proposed system [13]. The cost of the system, ability of the lens to identify and entire unit to process the images continuously cause the delay in the output and cannot be used in the real-time progress to solve the issue of drowsiness detection [14] [15].

Proposed Algorithm

Better Design of Spectacles

The design of the spectacles used for this drowsiness detection is very slim and compact, where drivers can easily adapt to use these, [16] and the lens of these spectacles can be changed if any sight error related problems to the driver. Moreover, the spectacles contain the control options within the edges, where the driver can control it accordingly [17].

Infrared Proximity Sensor

This sensor emits, Infrared rays and the light reflected is recorded by an IR photodiode. This blinking sensor is based on IR; there will be variations across the eye as per the blinking. The exact function depends on the position and aiming of the detector and emitter concerning the eye [18]. If the eye of the driver is closed, we get an output of digital logic 1. If the eye seems to be opened, then it gives the output as low(Digital logic 0). At last, the output of the proximity sensor is given to digital pins of the development board.

Compact Microcontroller with Bluetooth Enabled

The development board used here STM32 is very fast, and its compact size adds a benefit It is used for calculating the eye blink rate based on the input of the Ir sensor and the alarm based on comparison with the threshold value fed by the user or the manufacturer. This microcontroller is connected to the external sound alarm system using the Bluetooth communication within the vehicle and to the mobile phone where the alert sounds and the data can be sent to driver mobile.

Vibrators

The spectacles design consists of micro vibrators, [19] which can help to alert the driver with minimal delay after the drowsiness detection and these vibrator motors were placed on either side of the spectacles, to ensure high efficiency [20] [21]. This invention is a smart spectacle which consists of IR modules, Bluetooth module, microcontroller, and vibrator. This is a solution for the accidents due to the effect of sleep, drowsiness, and also due to the lack of

attention of the driver. This proposed model is the solution for the above type of problems. The basic mechanism is IR sensors count the blinking of eyes per minute [22], and the whole information is monitored by the microcontroller, which is embedded in the spectacles. If the blinking of eyes crosses the threshold value [23], then a notification is sent to the vibrator and to the mobile phone which is connected using Bluetooth [24] to the spectacles then the phone makes some odd loud sounds and the vibrator start vibrating till the person gets into the normal state and he/she needs to turn off the button which is embedded beside the microcontroller. This total mechanism uses energy so it gets charged by a rechargeable battery which is fixed beside the Bluetooth module and can be charged accordingly with the power supply within the vehicle or externally. The advantageous feature of this spectacle is that it can work on 5Volts voltage and can stand up with the battery for a longer time. The smart spectacles and the flow of the commands from the IR sensor detection of the eye blinking rate to the input to the microcontroller and the output of the microcontroller to the external vibrator and the mobile phone connected by Bluetooth if an alert has to be sent to the driver in the procedure of drowsiness detection. The above shown is the circuit diagram of the entire setup with connections of the battery and the other sensors on the macro scale with breadboard connections. This entire setup can be designed on the micro-scale using a printed circuit board so that the reduced circuit can be easily implemented on the spectacle and promote the proper design within the outfit to act as a driver alerting system.

EXPERIMENT AND RESULT

The design of the spectacles in the form of a prototype is shown with all the sensors and other components attached to it.

1. In this position of the spectacle, IR sensors are placed on both sides and will help in quick detection of eye blinking rate.
2. In this position, the microcontroller and battery are placed within the compact size by obtaining the printed circuit design of the microcontroller
3. The Bluetooth module is ensured to place in this position with a compact size printed circuit board by connecting it internally to the microcontroller.
4. The vibrators are placed on either side along the length of the spectacles to have a sleek design and provide comfort to the user while using them.
5. In this way, the design of the spectacles enhances to provide a solution to the drowsiness detection and promote safety feature in driving.

CONCLUSION

In this prototype, the entire spectacle module with different sensors, microcontrollers and other components interfacing with proper code and enhancing built it as a single module will help to develop the solution in preventing the accidents that are caused due to the drowsiness of the driver. Moreover, this solution can make an impact in many ways of providing good efficient output in detecting the rate of eye blinking accurately and intimate the driver as an alert by vibrations and sounds through the Bluetooth communication and acts as an efficient solution for driver drowsiness detection and warning system with higher effective output results.

ACKNOWLEDGEMENTS

The facial image used in this research article have been used with the permission of the person concerned. We would like to thank that person on behalf of our research team.

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Table 1: Existing system and proposed system

EXISTING SYSTEM	PROPOSED SYSTEM
Detection using camera	Detection using IR rays
Needs high processing power	This model can work with microcontroller based system
Complicated design	Smart design which adds comfort to the user
Consumes more power	Work with less power consumption
Less efficient	Provides much efficiency

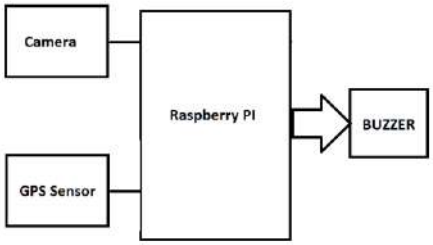

Fig.1. Existing Architecture

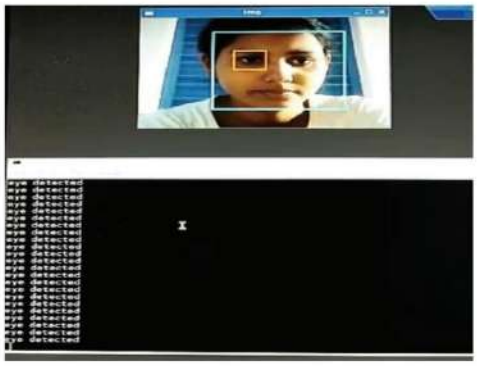

Fig.2. Eye and eye blink detection using Harcascade Algorithm

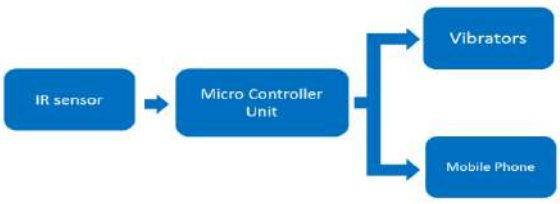

Fig.3. The Proposed Architecture of the Smart Sensing Spectacles.

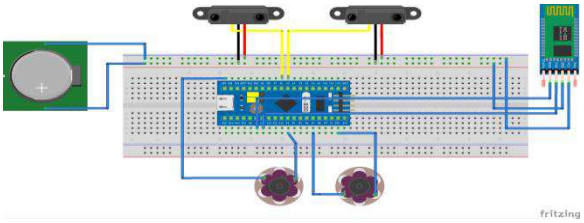

Fig.4. Circuit Design of Working Prototype

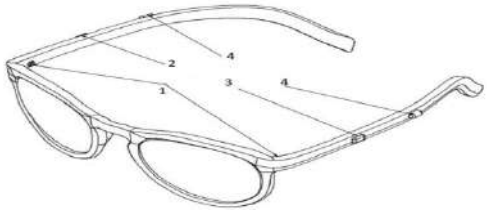

Fig.5. Design of the Prototype

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RESEARCH ARTICLE

The Role of Intravenous Zoledronic Acid 5 % W/V in the Treatment of Osteoporosis for Post-Menopausal Women

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ABSTRACT

Osteoporosis is marked by increased osteoclastic activity as it is a well known metabolic bone disorder. It mainly affects post-menopausal women due their decreased BMD after the age of 40. The current treatment strategy used for osteoporosis is bisphosphonates. An observational, retrospective , hospital-based case study was conducted at the orthopaedics department, VMKVMCH with a study population of 50 patients affected with osteoporosis. 50 patients were treated with Zoledronic acid 5% W/V. The chief complaints of the patients , BMD, and T-score were analysed. The values obtained were tabulated and statistically analyzed to determine the efficacy of the test drug. The study proved that the major chief complaints of the patients were reduced by a single infusion of Zoledronid acid 5% W/V once in 6 months. Similarly, the treatment was also effective in increasing calcium, BMD, and T-Score values. No treatment- related adverse effects were reported in the study population . A single infusion of Zoledronic acid (5%W/V) proved to be more effective for post menopausal women affected with osteoporosis as it shows good patient tolerability and safety profile.

Keywords: Osteoporosis, Zoledronic acid, Body Mass Density, T-score, fracture, calcium.

INTRODUCTION

Osteoporosis is defined as decreased bone mass density which results in permeable bone, associated with high fracture risk. The declining oestrogen levels trigger bone deterioration and increased risk for fractures in postmenopausal women [1]. In an aging population, osteoporosis is becoming an increasing global concern. Currently, more than 200 million people are affected with osteoporosis due several reasons. With an early diagnosis and treatment osteoporosis can be prevented [2]. Age, a low body mass index, history of previous osteoporotic fracture, smoking, and rheumatoid arthritis are the major factors leading to osteoporosis. Until a fracture is seen , it remains as a silent disease. The majorlaboratory findings that confirm osteoporosis include a low BMD, calcium values less than 6 mg/dL, and decreased T-score values. The major complications associated with the disease include fracture along with severe pain, swelling, and tenderness in the affected areas. Fractures that occur suddenly after minor trauma are more common in osteoporotic individuals [3]. The first complaint reported by the patient might be dropping of height due to vertebral compression, which indicates the presence of multiple fractures [4]. Osteoporosis is classified as primary and secondary osteoporosis. Primary osteoporosis is further classified as type 1or postmenopausal osteoporosis and type 2 (senile)which affects both men and women [5]. Certain underlying comorbid conditions along with intake some medications can cause secondary osteoporosis. Osteogenesis Imperfecta (OI) or brittle bone disorder is a genetically acquired syndrome [6].

The various diagnostic approaches include radiography as decreased bone density is the main feature of osteoporosis. Nowadays DEXA scanners with a high-energy X-ray beam is used to calculate and compare BMD values [7]. The prevalence of fractures in individuals is predicted by Fracture Risk Assessment Tool Model (FRAX). Vertebral imaging is used to detect asymptomatic vertebral fractures [8]. A wide range of pharmacological treatments like vitamin D analogs and topical analgesics have been used to manage osteoporosis. However, bisphosphonates have been proved to be very effective. The use of oral bisphosphonates like Alendronate is generally dimnished due to its poor absorption and reduced patient compliance [9]. As Zoledronic acid is generally safe and well tolerated it is used for treating osteoporosis most commonly in postmenopausal women. It is administered in a 12-month dosing interval and dosen't cause any GI problems associated with oral Alendronate [10].

MATERIALS AND METHODS

The role of intravenous Zoledronic acid 5% W/V in the treatment of osteoporosis for postmenopausal women was determined by conducting a retrospective study. For the purpose of the study, 50 patients were recruited . The patients who were admitted from October 2019 to March 2020 to the hospital were coordinated for the study. The case records were collected from Vinayaka Missions Kirupananda Variyar Medical College, and Hospitals, Salem, Tamilnadu. All the relevant pieces of informations were collected from the patient case sheets. Female patients aged between 45 to 85 and with a T-score of less than 1.5 were selected for the study. The selected 50 patients were treated with Zoledronic acid 5 %W/V. The presenting chief complaints of the patients along with their BMD and T-score values before and after the treatment with the test drug was recorded. The mean of BMD , T score and calcium values were calculated and compared. Patients with other secondary illness and hypersensitivity to Zoledronic acid were eliminated from the review.

RESULTS

Analysis of the study population

The total number of patients recruited for the study was 50. The patients were divided according to their age groups. The majority of patients were found among the age group of 60-70 (40%). Based on the inclusion criteria post-menopausal women above 45 years were recruited for the study.

Prevalence of chief complaints among the study population

The major chief complaints experienced by the patients like severe pain, swelling in the affected areas, and tenderness were assessed. As shown in table no:2, before treatment with the test drug , selected group among age group of 70 to 80 experienced severe pain along with tenderness and swelling. After the treatment the chief complaints were reduced to moderate pain, swelling, and tenderness. The other age groups also experienced similar reduction in symptoms.

Assessment of calcium values among the study group

The calcium values of 50 patients were collected before 6 months that is before treatment with intravenous Zoledronic acid (5%W/V). The values collected were recorded as shown in table no:3. The mean value before treatment was found to be 7.16 mg/dl.After 6 months that is treatment with intravenous Zoledronic acid 5%W/V the mean calcium values were found to be increased to 9.15mg/dl. Zolendronic acid was found to be effective in increasing calcium resorption in osteoporosis patients.

Analysis of BMD values among the study group

The BMD values of 50 patients were collected before 6 months that is before treatment with intravenous Zoledronic acid (5%W/V). The values collected were recorded as shown in table no:4. The mean value before treatment was found to be 0.7724gm/cm^2. After 6 months that is treatment with intravenous Zoledronic acid 5%W/V the mean BMD values were found to be increased to 1.15gm/cm^2.

Assessment of T score among the study group

The values of 50 patients were collected before 6 months that is before treatment with intravenous Zoledronic acid (5%W/V). The values collected were recorded as shown in table no:5. The mean T-Score before treatment was found to be -2.958 mg/dl. After 6 months of treatment 0.014 was reported as increased T-score value.

DISCUSSION

Osteoporosis is prevented and treated by a common option called bisphosphonates. Nevertheless, effectiveness of oral bisphosphonates like Alendronate is generally reduced due to its poor persistence and compliance.(9)A comprehensive review by Aziz K, Imam *et al* concluded that intravenous administration of Zol5%W/V appeared to reduce fracture risks in postmenopausal women. Zoledronic acid is an antiresorptive agent which ensures the proper absorption of calcium and increases the BMD [11]. In this study intravenous Zoledronic acid 5%W/V was administered to the selected study population containing 50 patients and were examined for their chief complaints, BMD, calcium, and T-score values. From this study, we observed that a yearly infusion of Zoledronic acid 5% W/V was very effective in reducing symptoms that were predominant in osteoporotic women. The cheif complaints of patients were collected and tabulated. Most of the patients were the age group of 60-70 experienced severe pain, swelling and tenderness during the admission . After treatment with the test drug the major symptoms for patients reduced from severe to mild pain, swelling, and tenderness. The mean calcium value before treatment was found to be 7.16mg/Dl . The mean calcium values after treatment was calculated and it was found to be 9.16 mg/Dl .It was observed that calcium increased after the treatment with i.v Zoledronic acid 5%W/V. The BMD scores of the patients were recorded and analysed. Mean BMD scores before treatment with drug was found to be 0.7724gm/cm^2. After treatment with the drug the BMD value increased to 1.15gm/cm^2 [12]. The mean T -score value before treatment was found to be -2.958mg/dl. Mean T-score value after treatment was calculated and recorded as -0.0414 mg/dl. The T-score values were increased after treatment with Zoledronic acid 5%W/V which was also reported by a study conducted by Micheal maricic *et al.*

CONCLUSION

Treatment with Zoledronic acid (5%W/V) once in 6 months was very effective in reducing the major chief complaints of the subjects . Similarly, the treatment was also very effective in increasing calcium, BMD, and T-Score values. Thus a single infusion of Zoledronic acid (5%W/V) was found to be more effective for post menopausal women affected with osteoporosis as it shows good patient tolerability and safety profile.

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Table 1. Analysis of group population with test drug

AGE GROUP	NO.OF PATIENTS	PERCENTAGE (%)
40-50	4	8
50-60	15	30
60-70	20	40
70-80	11	22
GRAND TOTAL	50	100

Table no:2 Analysis of chief complaints among the study population

AGE GROUP	PAIN	SWELLING	TENDERNESS	WARMTH	CREPITUS	TINGLING	JOINT STIFFNESS	LOSS OF CONSCIOUSNESS
Before treatment								
40-50	3	0	3	1	0	0	0	1
50-60	14	3	8	4	6	1	4	3
60-70	20	4	10	3	4	6	4	0
70-80	9	4	8	2	2	1	1	0

AGE GROUP	MILD PAIN	MODERATE PAIN	MILD SWELLING	MODERATE SWELLING	MILD TENDERNESS	MODERATE TENDERNESS
After treatment						
40-50	4	0	4	0	4	0
50-60	15	0	14	1	14	1
60-70	15	5	20	0	20	0
70-80	0	11	1	10	1	10

Table 3. Assessment of calcium values among study group

AGE GROUP	**CALCIUM(5-6 mg/dl)**	**CALCIUM(6-7 mg/dl)**	**CALCIUM(7-8 mg/dl)**	**CALCIUM(8-9 mg/dl)**
Before treatment				
40-50	0	0	1	2
50-60	1	5	7	1
60-70	0	5	8	6
70-80	0	4	1	4

AGE GROUP	**CALCIUM(8.5-9 mg/dl)**	**CALCIUM (9-9.5 mg/dl)**	**CALCIUM (9.5-10 mg/dl)**
After treatment			
40-50	1	2	1
50-60	1	4	10
60-70	4	12	4
70-80	10	0	1

Table 4 Analysis of BMD values among study group

AGE GROUP	BMD(0.75 gm/cm²)	BMD(0.76 gm/cm²)	BMD(0.77 gm/cm²)	BMD(0.78 gm/cm²)	BMD(0.79 gm/cm²)	BMD(0.8 gm/cm²)
Before treatment						
40-50	1	1	0	0	1	1
50-60	3	3	2	3	3	0
60-70	4	4	4	2	3	3
70-80	2	1	2	1	3	1

AGE GROUP	BMD(0.8-1 mg/cm2)	BMD(1-1.2 mg/cm2)	BMD(1.2-1.5 mg/cm2)
After treatment			
40-50	0	1	3
50-60	3	5	7
60-70	2	4	14
70-80	7	1	3

Table 5. Assessment of T-score among study population

AGE GROUP	T-SCORE(-2.5 to -3)	T-SCORE(-3 to -3.5)	T-SCORE(-3.5 to -4)
Before treatment			
40-50	1	1	2
50-60	9	4	2
60-70	7	10	3
70-80	7	4	0

AGE GROUP	T-SCORE(-0.1)	T-SCORE (-0.2)	T-SCORE (0.04)	T-SCORE (0.05)	T-SCORE (0.06)
After treatment					
40-50	0	0	0	2	2
50-60	0	0	2	8	5
60-70	0	0	3	8	9
70-80	2	1	6	2	0

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RESEARCH ARTICLE

IoT Enabled Smart Agriculture Monitoring System

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ABSTRACT

The internet of things (IoT) is reshaping agriculture, enabling farmers to overcome challenges in the field using a variety of techniques such as precision and sustainable agriculture. IOT technology aids in the collection of information about weather, moisture, temperature, crop growth, and agriculture. To connect to his farm from anywhere and at any time, he uses the IOT range of formats. Wireless sensor networks are used to control and automate the farm processes.

Keywords: Arduino UNO R3 board, pH probe Sensor, Wifi, Notification System,IoT.

INTRODUCTION

This "IOT Based Smart Agriculture System" is designed to develop an IOT-based automation irrigation system that turns the pumping motor on and off in response to a command sent via the IOT Platform. Reduce the amount of water used [1-2]. Agriculture has been practised for millennia in every country. A temperature sensor, moisture sensor, water level sensor, Dc motor, and GSM module are all part of this Arduino-powered smart farm system [3-7]. The water, humidity, and moisture levels are checked when the IoT-based farm monitoring system is turned on. Using existing network infrastructure, the internet of things allows objects to be identified and operated remotely, allowing for more direct physical world integration into computer-based systems. It also focuses on ensuring the most efficient use of water resources in order to handle issues like water scarcity and ensure long-term sustainability. The proposed solutions in this work will improve farming methods, increase productivity, and lead to more efficient use of scarce resources [8]. The solutions provided in this paper will improve farming processes, increase productivity, and lead to effective use of limited resources [9]. This module focuses on the use of IOT in agriculture. The work plan is to support the young future generation to choose the crop in the agriculture field in an easy manner for different type of soil. By seeing the growth of the plant the future generation will have more interest in the Agriculture field and the increase in the agriculture growth[10].

PROPOSED SYSTEM

In this proposed system, the basic fundamental building block diagram of an IoT Systems is Sensors, Arduino UNO and the applications. As a result, the fundamental building block diagram below is a suggested model for our proposed work, and it depicts the relationships between the diagram's blocks. In our suggested work, the sensors are connected to an Arduino UNO, and the data collected from the sensors is used to show information on the user's mobile app. The smartphone app provides a method for collecting continuous data from sensors and assisting the farmer in taking suitable actions to manage the soil's requirements. The fig 2 shows the flowchart, when data is collected from various sensors, such as humidity, temperature, soil moisture level, and PH value level, it is sent to the mobile app for the user in our proposed work, and if the water content level in the soil is less than the threshold value, an alert SMS message is collected on the mobile app for the user in our proposed work, and the motor is switched on spontaneously using the relay in our proposed work.

HARDWARE DESCRIPTION

Soil moisture sensor

The soil moisture sensor includes three pins: one for voltage input in the moisture sensor, one for ground in the moisture sensor, and one for analogue input in the moisture sensor. In agriculture areas, the content level of the soil (volume percent) is regulated by the soil moisture sensor. Because the soil moisture sensor content level is determined in percentage, the analogue level value must be surveyed in the range of 0-100. The image of a Soil Moisture Sensor is shown in Fig 3.

ARDUINO UNO R3 BOARD

There are six analogue input pins labelled A0 to A5 that can be used to connect up to six analogue sensors directly to the Arduino. The Arduino Uno R3 board is shown in Figure 4. A total of two power sources with in-built voltage control, designated 3.3 volts and 5 volts, are used to power sensors. A USB plug that can be used to connect a microprocessor to a computer through a USB cable.

MOTOR

The motor is a small submersible pump that which functions on the dc 3-6v with the cost well organized and the portable in the motor. The motor is able to take the about 120 liters for an each and every hour with the especially the low supply current application in the motor. Fig.5 shows the picture of Pump motor.

RELAY

The relay shown in fig 6 is a switching device in our proposed work. To the relay is automatically controlled by the switch and many of the relays are used in the electromagnet but several more fundamentals device can also be used like relays whatever are the solid state in our proposed work. The relays are utilised in this proposed work when it is used in the major to operate a circuit by the method of unconventional low power signal or if the different circuits are controlled by a single signal. So, in this proposed work, the relay functions as an automatic switch that operates on a high-current circuit using a low-current signal..

HARDWARE SETUP

The Fig 7 shows that the experimental setup of smart agriculture monitoring system. The experimental setup contains the Arduino UNO and that then the different sensors they are the soil moisture sensor, the soil pH sensor, GSM module and the last one is the Motor and which is connected through the relay. The Arduino UNO serves as the foundation Temperature, humidity, soil moisture level, and soil pH value are all streamed live, as well as sending sensor data to the cloud server via the ESP8266 Wi-Fi module. The data collected from the various sensors is then sent to the mobile app, which displays the soil pH value on the LCD. The Arduino UNO is used to link all of the sensors, which are then connected to the power source. The Arduino UNO is used to read the readings from the various sensors and then sends the data to a cloud server. When the moisture content of the soil falls below a specified threshold value, the relay turns on, causing the motor to turn on automatically. When the soil moisture content rises over the threshold level, the relay turns off, causing the motor to turn off automatically.

RESULTS AND DISCUSSION

We have measured the temperature, soil moisture, LDR and CO2 at the time of the day and the figures below show the results of all the sensor reading. The above figures show the value of the temperature, value of soil moisture, value of CO2 and value of LDR use the mobile app at a specific time of day. The above figures show the variation of soil moisture, temperature, CO2 and LDR respectively with the time. These graphs show data collected in real time on the thingspeak IoT Cloud. The soil pH sensor measures the pH value of soil. This soil pH values are displayed on the LCD. Then we compared the pH values to the collected data. If the pH values are same as the data's then the GSM module device forwards the message to the user.

CONCLUSION

The Proposed prototype investigates the application of the Internet of Things (IoT) in agricultural settings. This prototype aims to increase crop output by incorporating a larger crop pattern into the suggested work for a specific soil in the field. Thingspeak IoT Platform aids in the real-time process of soil in agriculture fields, and so the data collected may be used for crop research in the fields. We've also conducted multiple investigations of soil moisture, temperature, and humidity in agriculture areas over several days and at various times of the day. The cloud data also aids agriculturists in increasing output yield, analysing droppings, and reducing chaos in the agriculture fields. This strategy is both practical and cost-effective. It also looks at how to use water resources to solve problems like water scarcity and field sustainability. The solutions suggested in this paper will improve farming practises in the fields, increase production, and lead to the efficient use of scarce resources, making this model unique in that it focuses on the use of IoT in agriculture fields.

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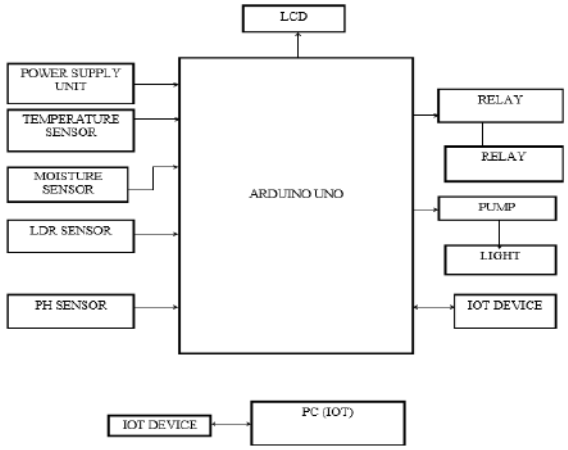

Fig 1. Proposed Block Diagram of Smart Agriculture System

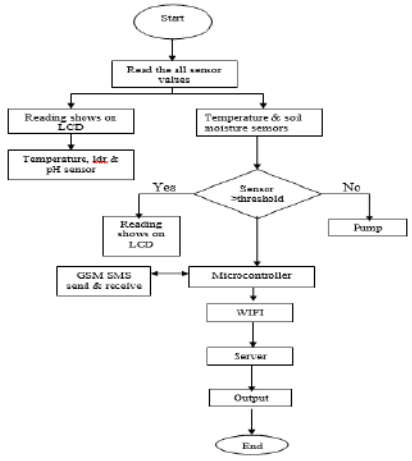

Fig 2. Flowchart of Proposed Model

Fig 3. Soil Moisture Sensors

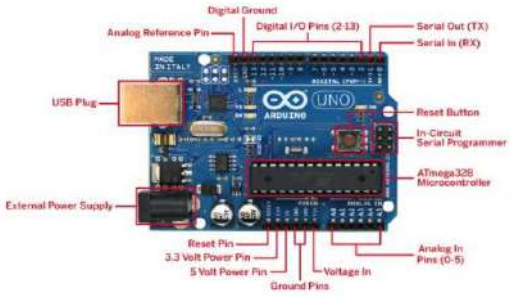

Fig 4. Arduino UNO R3 board

Fig 5: Pump motor

Fig 6. SMD Relay

Fig: 7 Hardware Set up of the Proposed System

Fig 8. Graph of Temperature

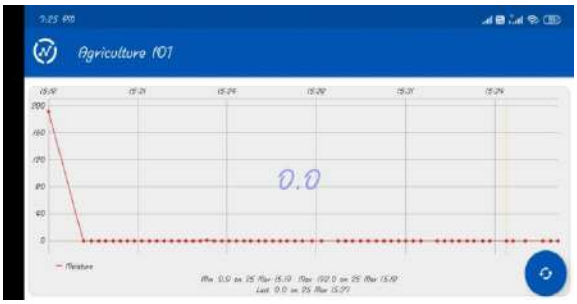

Fig. 9. Graph of Soil Moisture

Fig. 10. Graph of Co2

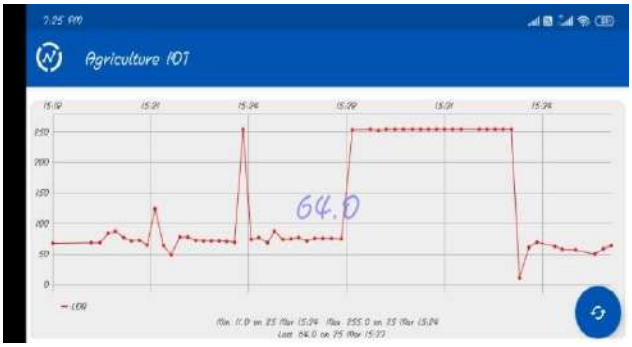

Fig. 11. Graph of LDR

RESEARCH ARTICLE

Phytochemical and Antimicrobial Screening of *Tithonia diversifolia* (Hemsl) A. Gray. Leaf

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ABSTRACT

The use of medicinal plants has gained more importance because of their natural origin and high therapeutic significance. The phytochemical screening of methanol and aqueous extracts from the leaves of *Tithonia diversifolia* showed the presence of phytoconstituents such as carbohydrates, proteins, flavonoids, alkaloids, glycosides, terpenoids and steroids. The present work aims to study the effect of methanolic and aqueous leaf extracts of *Tithonia diversifolia* on antibacterial (*Escherichia coli*, *Staphylococcus aureus*) and antifungal (*Aspergillus niger*, *Aspergillus flavus*) activity. Ingeneral, both the extracts exhibited significant inhibition against all the tested bacteria and fungi. However, the methanolic leaf extract of the studied plant showed higher inhibition than that of aqueous extract. It was evident that at higher concentrations magnitude the zone of inhibition in higher level.

Keywords: *Tithonia diversifolia*, Phytochemical analysis, Antimicrobial activity, Asteraceae

INTRODUCTION

Medicinal plants are nature's gift to human beings to make disease free healthier life. Because plants possess miraculous and dangerous power, which could alleviate pain and also cure of illness. Despite recent development in synthetic drug discoveries, plants still occupy an important place in the modern and traditional systems of medicine

all over the world. Medicinal plants, which constitute a segment of the flora provide the raw material for use in all the indigenous systems of medicine in India, namely Ayurveda, Unani, Siddha, and Tibetan medicine (Das, 2008). The World Health Organization that approximately 80% of the world's inhabitants rely mainly on traditional medicines for their primary healthcare. Plant based products also play an essential role in the healthcare systems. The remaining 20% of the population depends primarily on residents of developing countries. The genus *Tithonia* and its species are used to treat ailments such as intestinal complications, hemorrhoids and circulatory disorders. A variety of phytocompounds found in plants are useful in human and veterinary medicines (Sajal et al., 2014). So an analytical work in this line is necessary to analyse the phytochemical screening and antimicrobial activities of the common plant namely *Tithonia diversifolia* under the family Asteraceae.

MATERIALS AND METHODS

Plant Collection And Identification

Tithonia diversifolia leaves were collected in November 2019 from Anthiyur, Erode District. With the help of "Hebarium Specimen available in Department of Botany, Vellalar College for Women.

PREPARATION OF PLANT EXTRACTS

The collected plant materials were washed with tap water and dried under shade condition. The air dried leaves were ground into a coarse powder (Plate -1). For methanol extraction the Soxhlet apparatus was used and in the case of aqueous extraction cold perculation method was followed. About 20 gm of dried powder was packed with thimble and then subjected to were methanol extraction. The collected extract was concentrated by evaporation at room temperature and were stored for future analysis.

Syestametic position of *Tithonia diversifolia* (Hemsl) A. Gray.

Taxonomic Description

Kingdom : Plantae
Division : Tracheophyta
Class : Magnoliopsida
Order : Asterales
Family : Asteraceae
Genus : *Tithonia*
Species : *diversifolia*

Common Names

English : Mexican Sunflower, Nitobe Chrysanthemum
Tamil : KattuSuryakanthi
Malayalam : Kaippanpachha, VeliSuryakanthi

Preliminary phytochemical analysis:

Methanol and aqueous extracts were subjected to preliminary phytochemical tests followed by the methods of Horborne (1984), Trease and Evans (1989), Kokate et al. (1995) and Prabhakaran (1996). Both the extracts were screened to confirm the presence of phytoconstituents like carbohydrates, proteins, alkaloids, phenols, tannins, flavonoids, terpenoids, glycosides, steroids, saponins and anthroquinones by using following tests. The tests were based on the visual observations of colour change or formation of precipitate after addition of specific reagents.

priliminary phytochemical studies

a) test for carbohydrates (anthrones test)

5ml Anthrone reagent was added to 3ml of sample seperately. The formation of yellow colour indicates the presence of carbohydrates.

b) Test for Proteins (Ninhydrin Test)
To the 3ml of test sample few drops of Ninhydrin was added and boiled for few minutes. The presence of the compound was indicated by the formation of blue colour.

c) Test for Alkaloids (Wagner's Test)
To 1ml of test solution few drops of Wagner's reagent was added. The formation of yellow precipitate indicates the presence of alkaloids.

d) Test for Tannins (Ferric Chloride Test)
A few drops of 0.1% of ferric chloride was added to the 1ml of test solution. The presence was indicated by brownish green or a blue colour.

e) Test for Flavonoids (Alkaline Test)
To 2ml of test solution, 2ml of 10% NaOH was added. Intense yellow colour was formed which disappears on addition of dilute Hcl. This shows the presence of flavonoids.

f) Test for Terpenoids (Salwokski Test)
2ml of chloroform was added to the 3ml of test solution, and then 3ml of con.H2SO4 was added. A reddish brown colour in interphase indicates the presence of terpenoids.

g) Test for Steroids (Salwokskitest)
To 3ml of test sample, 1ml of chloroform and equal volume of H2So4 was added to the side of the tube. The upper layer turns red and lower layer turns yellow with green fluorescence which indicates the presence of steroids.

h) Test for Saponins (Foam Test)
Add 2ml of water to the test solution and shake well. Stable foam for 10-15 minutes indicates the positive result for saponin.

i**) Test for Glycosides (Acetic Acid Test)**
Glacial acetic acid and ferric chloride was added as drop to the test solution to that conc.H2S04 was added. A reddish brown colour for the indication of positive result.

j) **Test for Anthroquinones**
To 0.5 ml of extract was added with a few drops of Hcl. The mixture was taken and appearance of pink, red or violet color in the lower phase indicates the presence of anthroquinones.

Antimicrobial Activity
The tested microbial strains were collected from the Department of Biotechnology, KSR College of Technology, Tiruchengode, Namakkal District, Tamil Nadu.

Preparation of Inoculums
The bacterial organisms like Gram-positive (*Staphylococcus aureus*), Gram-negative (*Escherichia coli*) and the fungal organisms (*Aspergillus niger and Aspergillus flavus*) were pre cultured in nutrient broth overnight. Bacterial cultures were grown in Muller Hinton Agar medium and the fungal cultures are grown in Potato Dextrose Agar medium and these inoculums were used for antimicrobial assay.

Composition of Medium
Muller Hinton Agar medium
Beef infusion : 300 g
Acid hydrolysate of Caesin : 17.5 g

Starch : 1.5 g
Agar : 17 g
Distilled water : 1 Lit.

Potato Dextrose Agar medium
Potato infusion : 200gm
Dextrose : 20 gm
Agar : 20 gm
Distilled water : 1 liter

Antimicrobial Assay
The above nutrients were weighed and dissolved in water. To dissolve the agar the mixture was warmed on water bath at 15 lbs. pressure, 121°C sterilized in an autoclave for fifteen minutes. The sterilized medium (20 ml) was poured into a sterilized petriplates under aseptic condition, allowing them to solidify. The plant extracts were tested against Escherichia coli, *Staphylococcus aureus*, *Aspergillus niger* and *Aspergillus flavus* by using the agar well diffusion assay for antimicrobial activity.

Agar Well Diffusion Assay (Bauer et al., 1968)
The plant extracts were tested for antibacterial and antifungal activity. The Agar well diffusion method was employed for the determination of antimicrobial activity of the methanol and aqueous extracts. The bacterial cultures were inoculated in nutrient broth and the fungal strains were inoculated in PDA broth at 37°C for overnight. The Prepoured plates were inoculated by dipping sterile swab into inoculums. The excess inoculum was removed by pressing and rotating the swab firmly against the side of the tube. The swab was streaked well all over the surface of the medium, rotating the plate through an angle of 60°C after each application. Finally, the swab was passed around the edge of the agar surface then closed with the lid. The inoculation was dried for a few minutes at room temperature. With the help of cork borer put a well in the place at a regular interval. Add standards hloramphenicol (30mg) as standard used for bacteria and Miconazole (30mg) as a standard for fungi and extracts in different concentration (20µg, 40µg and 60µg) in the well. Within in 30 minutes, the plates were incubated at 37°C for bacteria and 22°C for fungi. After incubation approximate period for bacteria is two days and 7 days for fungi. The zone of diameter of inhibition (including the diameter well) was measured and recorded in millimeter (mm). The measurements were taken with a ruler, from the bottom of the plate, without opening the lid.

RESULTS AND DISCUSSION

The phytochemical constituents of *Tithonia diversifolia* were evaluated both methanol and aqueous extracts by using qualitative phytochemical tests. The presence was expressed as (+) and the absence was expressed in (-) symbol. The antimicrobial activities of *Tithonia diversifolia* was tested against bacteria like *Escherichia coli* and *Staphylococcus aureus* and against fungi like *Aspergillus niger* and *Aspergillus flavus* by measuring the diameter of zones of inhibition.

Qualitative Phytochemical Analysis of *Tithonia diversifolia*
The phytochemical screening of methanol extract from the leaf of *Tithonia diversifolia* showed the presence of phytochemical constituents such as carbohydrates, proteins, flavonoids, alkaloids, glycosides, terpenoids and steroids. At the same time, the phytochemical constituents like tannins, saponins and anthroquinone were totally absent. The results obtained from the qualitative phytochemical studies are given in table-1. Similar results of phytochemical screening of methanol extract of *Tithonia diversifolia* leaves were obtained by (Dabai et al., 2012). Vijaya Bharathi et al., 2018 reported the presence of phytoconstituents like steroids, flavonoids, glycosides, tannins and carbohydrates from the leaves and seed extracts *Tithonia diversifolia* of this is in accordance with the present investigation. The medicinal plant species of *Tithonia diversifolia* was screened to detect the presence of several bioactive compounds which are reported to cure different diseases and ailments. Same active principles have also

been reported by (Bhalerao and Kelkar, 2012; Dabai et al., 2012 and Gollo et al, 2016). Presence of these compounds can be correlated with the medicinal potential of the plant. The effect of methanol and aqueous extracts of *Tithonia diversifolia* were tested against two species of bacteria namely *Staphylococcus aureus and Escherichia coli* and against two species of fungi namely *Aspergillus niger* and *Aspergillus* using agar well diffusion method. The standards used were Chloramphenicol (30mg) and Miconazole (30mg). The antibacterial activity was undertaken against *Staphylococcus aureus and Escherichia coli*. Methanol extract of *Tithonia diversifolia* showed a potent activity against the tested bacterial organisms. And the aqueous extract of *Tithonia diversifolia* also showed potent activity against both bacterial organisms. Among the two different extracts higher zone of inhibition was showed in a methanolic extract which were compared with standard Chloramphenicol and aqueous extract (Table-2, Plate-2). The antifungal activity was undertaken against *Aspergillus niger* and *Aspergillus flavus*.

Methanol and the aqueous extract of *Tithonia diversifolia* showed a potent activity against both fungal organisms. Among the two extracts more inhibitory zone was showed in a methanol extract when compared with standard Chloramphenicol and aqueous extract(Plate-3, Table-3). The presence of the identified phytochemical components makes the leaves medicinally active. In the proximate analysis the leaf nutrients in the plant that are useful for many pharmacological activity. The continuous development of antibiotic resistance of pathogenic microorganisms is a major health concern worldwide. The screening of plant materials and their isolated substance for new antimicrobial compounds represent an important source for new effective medicines. According to (Masko et al.,2010) the leaf extracts showed a range of activity against all the bacteria and fungi. In this study, the plant extracts of both methanol and aqueous were used to evaluate its inhibitory properties on selected plant pathogens. According to Sulieman et al., 2017, methanol extract of *Tithonia diversifolia* plant produce more inhibitory zones against the bacteria like *Escherichia coli, Klebsiella pneumonia, Acinetobacter baumannii, Pseudomonas aeruginosa, Staphylococcus aureus* and *Salmonella spp*. Anushia et al., 2009 reported that the antifungal activity against *Trichophyton mentagrophytes* and *Epidermophyton floccosum* and antibacterial activity againsti.e. *Bacillus megaterium, Streptococcus haemolyticus* and *Shigella boydii* in the seed extracts of *Cassia fistula*. Sood et al., 2012 studied the antimicrobial activity results against *Escherichia coli, Aspergillus niger, Aspergillus flavus, Fusarium moniliformae* and *Rhizoctonia baticolain Cassia reningera*. Our findings were well coincided results obtained by above mentioned researchers.

CONCLUSION

From the present study it can be concluded that the plant showing high antimicrobial activity it may be owing to the presence of above tested secondary metabolites. The studied plant extracts are having antimicrobial activity and this plant can be used as sources for identify new drugs. From this we concluded that the methanolic extract was proved to be more efficient when compared to aqueous extract. But further spectral studies are needed to standardize this study plant.

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Table:1 Qualitative phytochemical screening of methanol and aqueous extract *Tithonia diversifolia*

S.No	Phytochemical constituents	Name of the Extract	
		Methanol	Aqueous
1.	Carbohydrates	+	_
2.	Proteins	+	_
3.	Alkaloids	+	+
4.	Tannins	_	+
5.	Flavonoids	+	+
6.	Terpenoids	+	+
7.	Steroids	+	_
8.	Saponins	_	+
9.	Glycosides	+	+
10	Anthroquinone	_	_

Note:+ = Positive,-= Negative

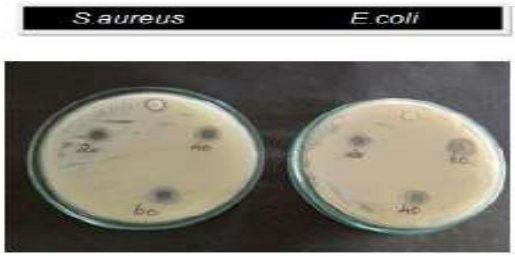
Table:2 Antibacterial activity of *Tithonia diversifolia* leaf extracts by agar well diffusion method

S.No	Name of the organism	Name of the Extract								
		Methanol			Aqueous			Standard Chloramphenicol		
		20µg	40µg	60µg	20µg	40µg	60µg	20µg	40µg	60µg
1	*Staphylococcus aureus*	0.7	0.8	0.9	0.5	0.5	0.7	1.2	2.2	2.2
2	*Escherichia coli*	0.6	0.7	0.8	0.3	0.4	0.6	2.2	2.2	2.2

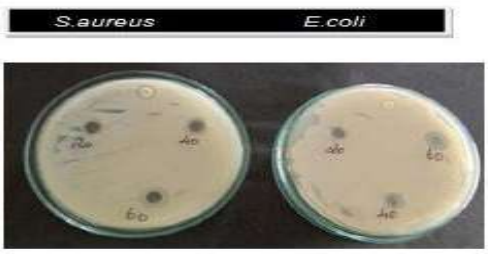
Table:3 Antibacterial activity of *Tithonia diversifolia* leaf extracts by agar well diffusion method

S.No	Name of the organism	Name of the Extract								
		Methanol			Aqueous			Standard Miconazole		
		20µg	40µg	60µg	20µg	40µg	60µg	20µg	40µg	60µg
1	*Aspergillusniger*	0.9	0.9	1.0	0.4	0.5	0.9	0.9	0.9	0.9
2	*Aspergillusflavus*	1.2	1.2	1.3	0.6	0.9	1.1	0.7	0.7	0.7

Figure1: A)Habit of *Tithonia diversifolia* **B)Coarse powder of *Tithonia diversifolia***

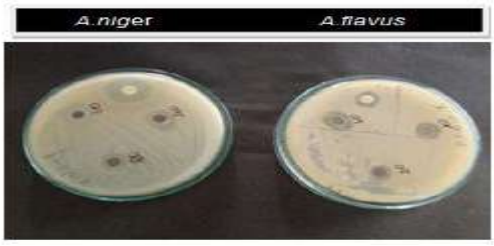


Methanol extract



Aqueous extract

Fig:2 Antibacterial activity of *Tithonia diversifolia* leaf extracts by agar well diffusion method



Methanol extract

Aqueous extract

Fig:3 Antifungal activity of *Tithonia diversifolia* leaf extracts by agar well diffusion method

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RESEARCH ARTICLE

CFD Analysis of Shell and Tube Heat Exchanger by Changing Geometrical Shape of Baffles

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ABSTRACT

Usage of Heat Exchangers are increasing in Industries like Power Generation, Marine Applications, Petrochemicals, Pharmaceutical, Oil and Refineries, etc. The Shell and tube heat exchangers consists of Shell, Tubes, Tube sheet, Baffle sets. On passage of time there were deviations in the design of Shell and Tube Heat Exchangers the intention of this work is about to swot-up the geometry of baffles and alter the geometry of baffle and reducing the shell side Pressure Drop, introducing some novel or fresh baffle geometry which is additionally efficient than segmental baffles, new customized baffle geometry is capable of producing higher turbulence on the shell side stream and improve the performance of shell and tube heat exchanger with appropriate baffle spacing and angular pact for angle of baffle. Fan type baffle geometry is introduced instead of segmental baffle heat exchanger which gives less Pressure Drop and better constancy weigh against to segmental baffle heat exchanger.

Keywords: STHE, FBHE, SBHE, Pr. Drop and Heat transfer co-efficient

INTRODUCTION

Shell and Tube Type of Heat Exchanger (STHE)

A shell and tube heat exchanger is the most common type of heat exchanger used in oil refineries and other large chemical processes. It suits high-pressure applications. It is utilized with higher working temperatures and weights. Another advantage is Pressure drop over a tube is less. As its name implies, this type of heat exchanger consists of a shell (a large pressure vessel). The bundle of tubes is arranged inside the shell. One fluid runs through the tubes, and another fluid flows over the tubes (through the shell) to transfer heat between the two fluids. The set of tubes is called a tube bundle, apart from Tube and Shell, Baffles are important part in design of Shell and Tube Type of Heat

Exchanger, TEMA has defined various shapes for the design of Front and Rear head as well as shell of Heat Exchanger.

Components of STHE

It is crucial that the designer working with STHEs have a thorough understanding of the mechanical design as well as thermal parameter design. The chief components of an STHE are: Shell, shell cover, Tubes, Tube sheets, Baffles, and nozzles, the secondary components include tie-rods and Spacers for spacing the tubes at designed distance from the shell casing, Pass divider plates, and longitudinal baffle, sealing strips to block the bypass flow and divert it into the tube bundle, supports and foundation for the shell.

Baffle

Baffles being an integral part of STHE provide support to the tube bundles especially when the length of the heat exchanger is too long, It maintain desirable velocity & path for the shell side fluid stream, Baffle create turbulence and resist tube vibration to enhance the fluid velocity as well as the heat transfer coefficient, Baffle is important part for calculating the Shell side Pressure Drop in the heat exchanger, changing in the baffle geometry affect the shell side Pressure Drop, helical baffles are having less Pressure Drop with compare to segmental baffle but fabrication of helical baffle is quite difficult especially when the diameter of the shell is too large so the researchers are) trying to develop variation of baffle geometry which resulting less Pressure Drop and increase in heat transfer co-efficient.

Baffle Shape

Baffle space is one of the prominent factor in the design of shell and tube heat exchanger, it affect the performance of shell and tube heat exchanger trisection, quadrant, helical are the different types of baffles, the single and double segmental baffles are most frequently used as they divert the flow most effectively across the tubes.

Baffle Spacing

It has been observed that Baffle spacing affects the performance of shell and tube heat exchanger, by increasing the baffle space while keeping the mass flow rate constant; it reduces heat transfer co-efficient. By increasing the baffle space at constant Pressure Drop, heat transfer co-efficient increases. Longer baffle spacing gives lower Pressure Drop also reduces power consumption. Generally in the design of shell and tube heat exchanger 0.4D to 0.6D baffle spacing is considered as standard practise.

Baffle Cut

The cut of baffle can be varied between 15% and 45% of the inside diameter of shell. It has been observed that very small and very large baffle cuts are damaging to operative heat transfer on the shell side due to large nonconformity from an ideal situation. If the baffle cut is too small, the flow will jet through the window area and flow unevenly through the baffle compartment, If the baffle cut is too large, the flow will short-cut close to the baffle edge and avoid cross-mixing within the baffle compartment, A baffle cut that is either too large or too small can increase the potential for fouling in the shell, In both cases, recirculation zones of poorly mixed flow cause thermal distribution of fluid that reduces heat transfer, To divert as much heat-carrying flow across the tube bundle as possible, adjacent baffles should overlap by at least one tube row, This requires a baffle cut that is less than one-half of the shell inside diameter, It is strongly recommended that only baffle cuts between 20% and 35% be employed, Reducing baffle cut below 20% to increase the shell side heat-transfer coefficient or increasing the baffle cut beyond 35% to decrease the shell side Pressure Drop usually lead to poor designs, Other aspects of tube bundle geometry should be changed instead to achieve those goals, For example, double segmental baffles or a divided-flow shell, or even a cross-flow shell, may be used to reduce the shell side Pressure Drop.

Theoretical Analysis of STHE

Introduction

Kern method and Bell Delaware method are generally used methods for mathematical design calculation of Shell and tube heat exchanger design, Kern method gives general approximate design data while Bell-Delaware method is

more efficient and gives more appropriate result than the result obtain from Kern method, It considered all Leakage factor, Bypass factor etc; So the mathematical calculation obtained by using Bell-Delaware method.

Governing Equations of Bell-Delaware Method

- Geometrical Dimensions extracted from Industrial drawing:
- Shell Internal Diameter Ds = 0.09 m
- No. of Tubes Nt= 7
- Tube outside Dia. Do = 20 mm
- Tube inside Dia. Di = 17 mm
- Tube pitch Pt = 30 mm
- Baffle spacing Lb = 86 mm
- Shell length Ls = 0.6 m
- Thickness of baffle Tb = 3 mm
- Tube to baffle clearance ΔTb= 0.1 mm
- Shell to baffle clearance ΔSb= 1 mm
- Bundle to shell clearance ΔBs = 2.5 mm
- Number of sealing strips per cross flow row Nss/Nc = 0
- Number of tube side passes = 1
- Shell Side Fluid = Water
- Total mass flow rate = 0.5 Kg/s
- Density = 997 Kg/m^3
- Thermal Conductivity = 0.6069 W/mK
- Specific Heat Capacity = 4.182 kJ/Kg K
- Viscosity = 467 μNs/m^2
- Following are the governing Equation used as per Bell-Delaware method. The Bundle
- Diameter DOTL = Ds- ΔBs
- Flow area near centre line $S_m = L_b \left[D_s - D_{OTL} + \left(\frac{D_{OTL} - D_o}{P_t}\right)(P_t - D_O)\right]$
- Heat transfer Co-efficient $h_o = \frac{N_u k}{D_o}$
- Baffle Cut Lc = 0.25 Ds = 0.05275 m $X = \frac{D_s - 2\,L_c}{D_{OTL}}$
- Correction factor $J_c = 0.55 + 0.72\,F_c$
- Tube to baffle leakage area $S_{tb} = \frac{\pi D_o\,\Delta T_b}{2} N_t \left[\frac{1+F_c}{2}\right]$
- Shell to baffle leakage area $S_{sb} = \frac{D_s\,\Delta S_b}{2}\left[\pi - \cos^{-1}\left(1 - 2\,\frac{L_c}{D_s}\right)\right]$, $\frac{S_{sb}+S_{tb}}{S_m} = P$, $\frac{S_{sb}}{S_{sb}+S_{tb}} = Q$
- Number of cross flow Row $N_c = \frac{D_s\left[1-2\frac{L_c}{D_s}\right]}{P_t}$
- Calculation of window-zone Pressure Drop $Y = \frac{D_s - 2\,L_c}{D_s}$
- Effective number of cross flow row $N_{cw} = \frac{0.8\,L_c}{P_t}$
- Window zone Pressure Drop $\Delta P_w = \frac{(2+0.6\,N_{cw})M_s{}^2}{2\,S_m S_w row}$

  By using P & R We can obtain the value of RL & Rb from Graph
- Shell side Pressure Drop $\Delta P_s = \left((Z-1)\,\Delta P_c R_b + Z\,\Delta P_w\right)R_1 + 2\Delta P_c R_b\left[1 + \frac{N_{cw}}{N_c}\right]$

Solution

Effect of tube geometry, shell geometry & baffle geometry on Pressure Drop is observed. It is observed from parametric analysis that with decreasing tube outer diameter, no. of tubes, shell length and number of baffle Pressure Drop can be reduced. It is observed from parametric analysis that with Increasing tube pitch, shell diameter, baffle cut percentage, baffle spacing and baffle thickness Pressure Drop can be reduced.

CFD Analysis of Shell and Tube Heat Exchanger

CFD is a powerful tool that is capable of comparing several heat exchangers under the same boundary conditions. CFD is a science that can be helpful for studying fluid flow, heat transfer, chemical reactions etc by solving mathematical equations with the help of numerical analysis. CFD employs a very simple principle of resolving the entire system in small cells or grids and applying governing equations on these discrete elements to find numerical solutions regarding pressure distribution, temperature gradients, flow parameters and the like in a shorter time at a lower cost because of reduced required experimental work, So Computational fluid dynamics (CFD) is used in this study to simulate the shell and tube heat exchanger, By using Fluid Flow CFX module in ANSYS 15 a shell and tube heat exchanger is analysed. By using this all geometrical dimensions 3D-model is prepared for analysis as shown in fig. below Grid independency test is carried out for checking the quality of meshing for heat exchanger, by changing the number of elements result of Pressure Drop is observed and it is observed that above 15,00,000 elements it gives the continuous value of result.

Grid Independency Test for SBHE

Governing Equations and Boundary Conditions

The temperature field and flow field are obtained by solving a set of equations with computational fluid and solid domains. For the fluid domains, the equations of mass, energy conservation and momentum are solved to model fluid flow, heat and mass transfer. Boundary condition at Shell Inlet and tube inlet is defined by Mass flow rate, outlet boundary conditions are defined by Gauge pressure 0 Pa, the value of pressure at inlet and outlet is observed from CFD.

Introducing STHE with Fan Type Baffle Geometry

The Geometrical model prepared by using same data of Segmental baffle Shell and tubeheat exchanger, shell diameter, shell length, no. of tubes, tube pitch are taken same and in the place of segmental baffles the new baffle geometry is introduced as the shape of baffleis like fan blade so it named as Fan type baffle geometry, CFD analysis of shell and tube heat exchanger with fan baffle geometry is to be carried out.

RESULTS AND DISCUSSION

Results Obtained For SBHE

The results are obtained from analysis as shown below, it is observed from analysis thatwith increasing of mass flow rate Pressure Drop is increasing. It is observed from analysis that with increasing of mass flow rate heat transfer co-efficient is increasing. At mass flow rate 10Kg/s, 9Kg/s, & 8Kg/s the inlet pressure obtained from CFD is 577kPa, 456kPa, & 361kPa respectively, and inlet temperature of shell side fluid is 400K; by using all this boundary conditions the values of shell side heat transfer co-efficient and Pressure Drop is observed as below. It is observed from analysis that with increasing of mass flow rate the values of heat transfer co-efficient and Pressure Drop is increasing; the graph shows the results for segmental baffle shell and tube heat exchangers.

Validation of CFD with Theoretical Calculation

The results are observed from CFX and for comparing the values three cases are made by varying the parameter mass flow rate and Pressure Drop and heat transfer co-efficient are observed. By comparing the values we are come to know that the value of Pressure Drop and heat transfer co-efficient are nearby in CFD analysis and Mathematical calculations obtain by using Bell-Delaware method; so we can say CFD results are validated with calculation.

Results Obtained For Spiral Baffle STHE

By using spiral baffle geometry the analysis is carried out At mass flow rate 10Kg/s, 9Kg/s, & 8Kg/s the inlet pressure obtained from CFD is 456kPa, 373kPa, & 295kPa respectively, and inlet temperature of shell side fluid is

400K; by using all this boundary conditions the values of shell side heat transfer co-efficient and Pressure Drop is observed as below.

Results Obtained For FBHE

By using fan type baffle geometry the analysis is carried out the results are shown below, the temperature contour and pressure contour are shown By using fan type baffle geometry the values are obtained and from Analysis it is observed that with increasing mass flow rate the values of heat transfer co-efficient and Pressure Drop is increasing but with compare to segmental baffle there is reduction in values of Pressure Drop is observed, At mass flow rate 10Kg/s, 9Kg/s, & 8Kg/s the inlet pressure obtained from CFD is 500kPa, 431.8kPa, & 330.6kPa respectively, and inlet temperatureof shell side fluid is 400K; by using all this boundary conditions the values of shell sideheat transfer co-efficient and Pressure Drop is observed as below. It is observed from analysis that with increasing of mass flow rate the values of heat transfer co-efficient and Pressure Drop is increasing; the graph shows the results for Fan type baffle shell and tube heat exchangers.

Comparison of Segmental Baffle STHE with Spiral Baffle & FanType Baffle STHE

Effect on Pressure Drop and heat transfer co-efficient is observed in all the three type ofheat exchanger and from results it is observed that in Fan type baffle heat exchanger 8 to 10% Pressure Drop is reduced while in spiral baffle the reduction in Pressure Drop is more around 25%, the reduction in Pressure Drop is based on its geometrical shape of baffles, due to curvature effect the turbulence is more in Fan type baffle heat exchanger due to high Reynolds no. Pressure Drop is decreased It is observed from analysis that with increasing of mass flow rate the values of heat transfer co-efficient and Pressure Drop is increasing in both the type of heat exchanger but there are some reduction in Pressure Drop is observed in fan type baffle heat exchanger.

Modification in Fan Type Baffle STHE

By varying the various parameters of fan type baffle like helix pitch, staggering angle, No. of blade various model of STHE made in CFD and by comparing the results optimum heat exchanger with a minimum Pressure Drop is prepared

Change in Staggering Angle of Fan Baffle Geometry

Staggering angle is defined as the rotation of baffles with each other, due to change in staggering angle the changes occurred in shell side flow pattern and change in Pressure Drop as well as heat transfer co-efficient is observed. The results are obtained by varying the Staggering angle as shown below from results it is observed that staggering angle 45° gives the minimum value of Pressure Drop aswell as heat transfer co-efficient.

Modified Fan Baffle Geometry with optimum Geometrical Parameters

By merging above all cases the optimum fan baffle geometry is created having 4 no. of blade, 45° staggering angle, and 50mm helix pitch is maintained and results are obtained for modified fan baffle geometry as shown below. The results obtained by modifying the baffle geometry are more optimum than earlier fan baffle geometry it gives lower Pressure Drop as shown in above results 25% reduction in Pressure Drop is observed while reduction in heat transfer co-efficient is quite less 10% compare to reduction in Pressure Drop.

RESULTS AND DISCUSSION

From the structural analysis it is shown that fan type baffle geometry is more stable to takeup the structural load compare to segmental baffle geometry so if we reduce one baffle from the heat exchanger still it can take up the load of tube bundle, by reducing one baffle from the heat exchanger again the results are obtained as below, in the beginning the parameters for fan baffle geometry like helix angle helix pitch and number of baffle blade is taken randomly after that modification in fan baffle geometry is carried out and by merging the optimum geometrical parameters the modified geometry of fan baffle is made and results of that modified baffle geometry is shown below

From the above results it is observed that in fan type baffle geometry reduction in Pressure Drop and heat transfer co-efficient is less compare to segmental baffle geometry; but the reduction in Pressure Drop is more compare to reduction in heat transfer coefficient, the above values shows that reduction in heat transfer co-efficient is near about 10% while reduction in Pressure Drop is near about 25%, now if we reduce one baffle from fan baffle geometry as fan baffle is having more structural stability further it reduce 27% Pressure Drop compare to segmental baffle, due to this large reduction in Pressure Drop it helps to saving pumping power, although reduction in heat transfer co-efficient reduce the.

CONCLUSION

Effect of baffle Geometry on Pressure Drop & heat transfer co-efficient is analyzed during the study, In place of segmental baffle Fan type baffle are introduced and results are compared with segmental baffle geometry as well as spiral baffle geometry. From the analysis it is observed that spiral baffle geometry is best than all the geometries as it gives low Pressure Drop than segmental baffle geometry but practically manufacturing of continuous spiral is not feasible especially for large diameter baffles so the usage of spiral baffle is not feasible.. Results from Fan baffle geometries shown that it is having 25% less Pressure Drop than segmental baffle and 10% less heat transfer co-efficient is observed, by modifying the baffle geometries further results are obtained which is more optimum than earlier results

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Table 1: Results Obtained By Mathematical Calculation

Parameters	Value	Unit
Flow area near center line, Sm	0.0201	m^2
Maximum intertube velocity, Vmax	5.303	m/s
Reynold's number, Re	212813	
Prandtl Number, Pr	3.22	
Crossflow Heat transfer Co-efficient, ho	28020	W/m^2K
Baffle cut, Lc	22.5	M
Fraction of tubes in crossflow, Fc	0.6094	
Correction factor,Jc	0.99	
Shell to baffle leakage area, Ssb	0.0000941	m^2
Tube to baffle leakage area, Stb	0.0000178	m^2
Corrected heat transfer Co-efficient, hc	26320	W/m^2K
Crossflow Pressure Drop, Kf	0.261	
Number of crossflow row, Nc	1.76	
Crossflow Pressure Drop, ΔPc	5.95	Pa
Window-zone flow area, Sw	0.00081	m 2
Effective number of cossflow row, Ncw	0.69	
Window zone Pressure Drop, ΔPw	78.6	Pa
Number of baffle, N	6	
Shell side Pressure Drop, ΔPs	498	kPa

Table 2: Geometrical Dimensions [16]

Shell size, Ds	90mm
Tube outer diameter, d0	20mm
Tube bundle geometry and pitch	30mm, Triangular
Number of tubes, Nt	7
Heat exchanger length, L	600mm
Shell side inlet temperature, T	300K

Baffle cut, Bc	36%
Central baffle spacing, B	86mm
Number of baffles, Nb	6

Table 3: Simulation conditions in CFX

Model	k-ε (Turbulent-Model)			
Solver	Steady state , First order			
Formulation	Implicit			
Buoyancy Model	Non Buoyant			
Morphology	Continuous Fluid			
Domain	Shell Steel	Shell Fluid-Water	Tube Steel	Tube Fluid-Water
Boundary Conditions	Shell side		Tube Side	
	Inlet	Outlet	Inlet	Outlet
Case:1	Mass flow rate **10Kg/s**	0 Pa	Mass flow rate 5Kg/s	0 Pa
	Temperature 400K		Temperature 300K	
Case:2	Mass flow rate **9 Kg/s**	0 Pa	Mass flow rate 4.5Kg/s	0 Pa
	Temperature 400K		Temperature 300K	
Case:3	Mass flow rate **8 Kg/s**	0 Pa	Mass flow rate 4 Kg/s	0 Pa
	Temperature 400K		Temperature 300K	
Interfaces	Solid-Fluid	Solid-Fluid	Solid-Fluid	
	Shell steel- Shell fluid	Tube steel-Shell fluid	Tube steel-Tube fluid	
Convergence Criterion	10^{-6} for pressure residual		10^{-3} for all other residual	

Table 4: Results Obtained from Segmental baffle

Result of segmental baffle geometry		
Cfd result		
Mass flowrate	**Pressure drop, kpa**	**Htc,w/m²k**
10 Kg/s	505	26988
9 Kg/s	400.3	24327
8 Kg/s	317	22057

Table 5: Results comparison

	Cfd result		Bell delawaremethod	
Massflowrate	**Pressure drop, kpa**	**Htc W/m²k**	**Pressure drop, kpa**	**Htc W/m²k**
10 Kg/s	505	26988	498	26320
9 Kg/s	400.3	24327	403	24575
8 Kg/s	317	22057	319	22762

Table 6: Results Obtained from spiral baffle

Result of Spiral Baffle Geometry		
Mass flowrate	**Pressure drop, kpa**	**Htc,w/m²k**
10 Kg/s	368	28651
9 Kg/s	299.7	25682
8 Kg/s	235.9	23660

Table 7: Results Obtained from Fan baffle

Result Of Fan Baffle Geometry		
Mass flowrate	**Pressure drop, pa**	**Htc,w/m²k**
10 Kg/s	415	24202
9 Kg/s	371	22282
8 Kg/s	288.4	20885

Table 8: Pressure Drop comparison between Segmental & Fan baffle

Massflowrate	Segmentalbaffle pressure drop, (kpa)	Spiral baffle pressure drop, (kpa)	Reductionin pressure drop, (kpa)	Fan baffle pressure drop, (kpa)	Reductionin pressure drop
10 Kg/s	505	368	27%	415	17.8%
9 Kg/s	400.3	299.7	25%	371	7.5%
8 Kg/s	317	235.9	25.5%	288	9.14%

Table 9: HTC comparison between Segmental & Fan baffle

Massflowrate	Segmentalbaffle htc, (w/m²k)	Spiral bafflehtc, (w/m²k)	Fan bafflehtc, (w/m²k)
10 Kg/s	26988	28651	24202
9 Kg/s	24327	25682	22282
8 Kg/s	22057	23660	20885

Table 10: Results for modified Fan baffle Geometry

Modified geometry of fan baffle (6 baffle)				
Mass flowrate	**Pressure drop, kpa**	**Htc,w/m²k**	**Reduction inpressure Drop, kpa**	**Reduction inhtc,w/m²k**
10 kg/s	**383**	**23935**	**24.15 %**	**11.3 %**
9 kg/s	**304**	**21989**	**24.01 %**	**9.6 %**
8 kg/s	**245**	**19818**	**22.7 %**	**10.15 %**

Table 11 :Results by reducing no. of baffle

	Mass Flow Rate, (Kg/s)	Pressure Drop,(kPa)	HTC, (W/m²K)	Reduction in Pressure Drop	Reductionin HTC
6 Baffle	10 Kg/s	383	23935	24.15 %	11.3 %
	9 Kg/s	304	21989	24.01 %	9.6%
	8 Kg/s	245	19818	22.7 %	10.15 %
5 Baffle	10 Kg/s	364	23067	27.9 %	14.5 %
	9 Kg/s	292	21210	27.1 %	12.8 %
	8 Kg/s	232	19170	26.8 %	13.1 %

Table:12 The minimum value of Pressure Drop aswell as heat transfer co-efficient.

CASE :1 Staggering Angle Comparison			CASE :2 Helix Pitch Comparison			CASE: 3 No. of Blade Comparison		
Staggering Angle	Pressure Drop, kPa	HTC, W/m²K	Helix Pitch (mm)	Pressure Drop, kPa	HTC W/m²K	Helix Pitch (mm)	Pressure Drop, kPa	HTC,W/m²K
60 °	415	24202	30	415	24202	30	415	24202
45 °	347	21759	40	372	23530	40	372	23530
30 °	425	23921	50	337	22920	50	337	22920

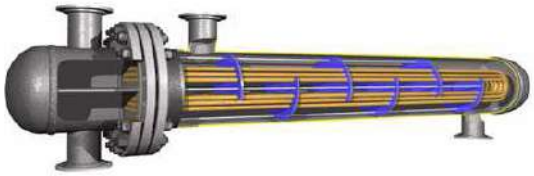

Figure 1:Shell and Tube Heat Exchanger [18]

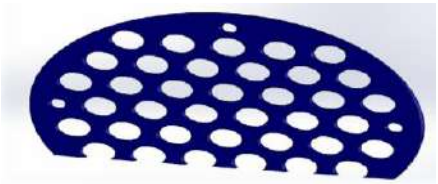

Figure 2: Segmental Baffle [17]

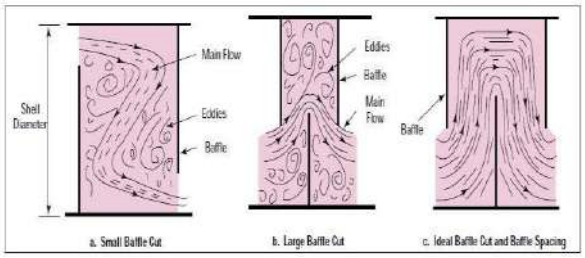

Figure 3: Baffle cut [18]

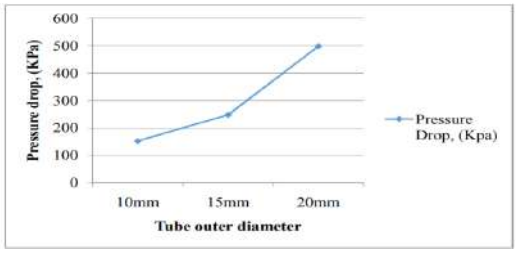

Figure 4: Pressure Drop Vs Tube outer diameter

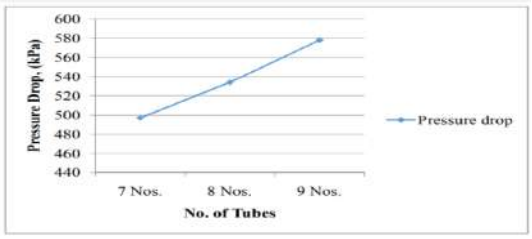

Figure 5: Pressure Drop Vs No. of Tubes

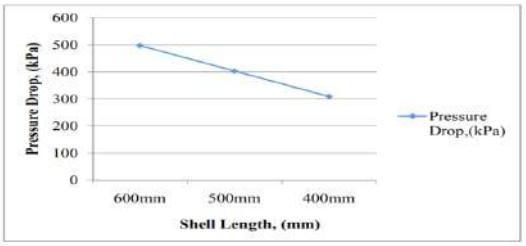

Figure 6: Pressure Drop Vs Shell length

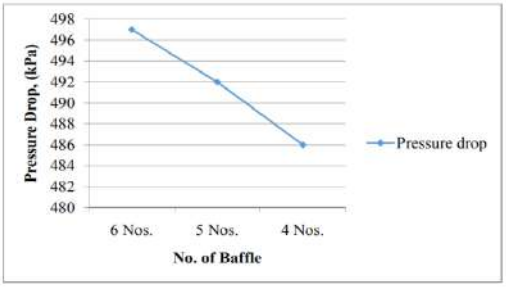

Figure 7: Pressure Drop Vs No. of baffle

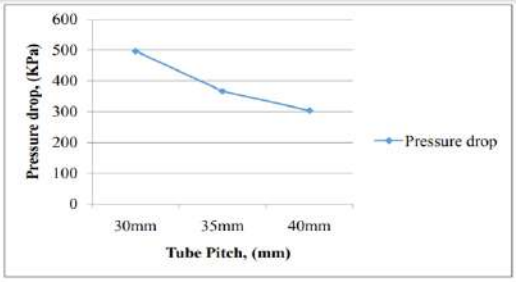

Figure 8: Pressure Drop Vs Tube Pitch

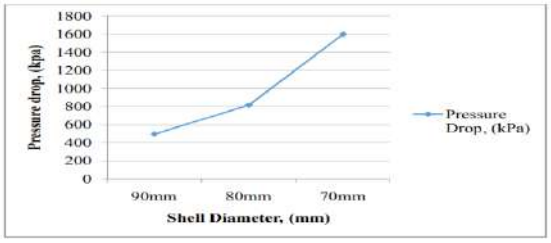

Figure 9: Pressure Drop Vs Shell Diameter

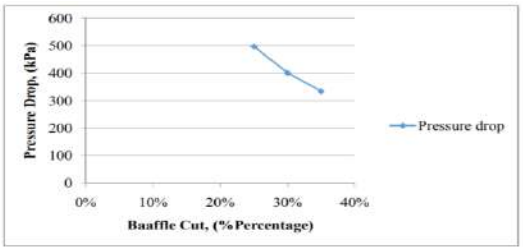

Figure 10: Pressure Drop Vs Baffle cut

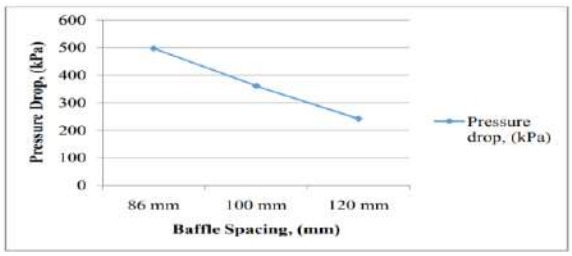

Figure 11: Pressure Drop Vs Baffle spacing

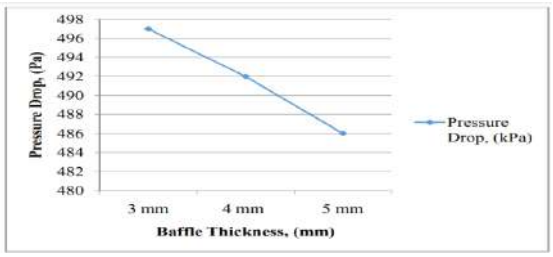

Figure 12: Pressure Drop Vs Baffle Thickness

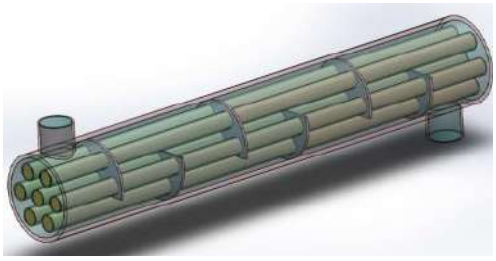

Figure 13: 3D Model for Analysis

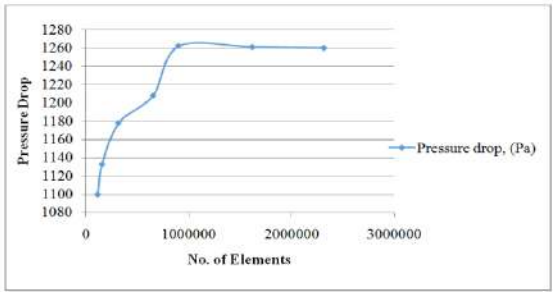

Figure 14: Grid Independency Test for SBHE

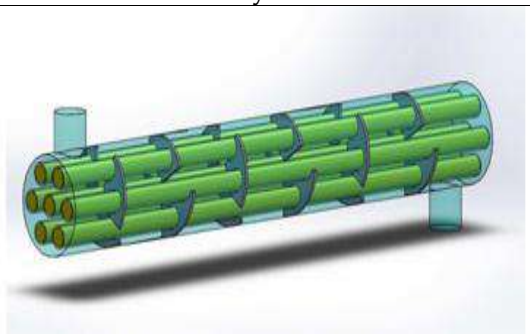

Figure15: STHE with Fan type baffle Geometry

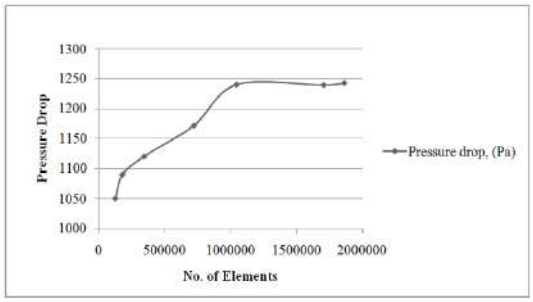

Figure 16: Grid Independency Test for FBHE

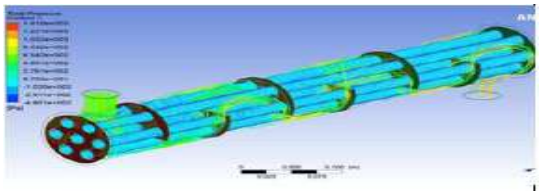

Figure 17:Pressure Contour for SBHE

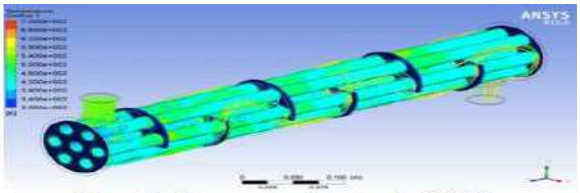

Figure 18: Temperature Contour for SBH

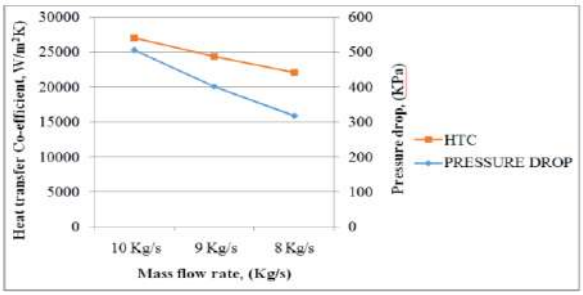

Figure 19: Pressure Drop Vs Mass flow rate for SBHE

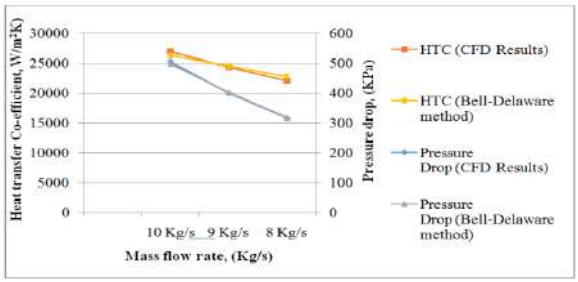

Figure 20: Pressure Drop Vs Mass flow rate comparison

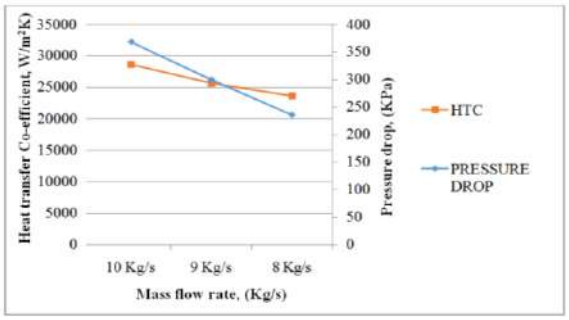

Figure 21:Pressure Drop & HTC Vs Mass flow rate for Spiral baffle HE

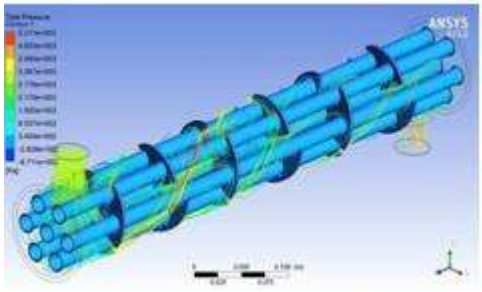

Figure Fig22: Pressure Contour for FBHE

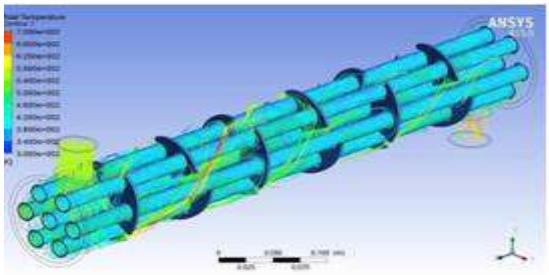

Figure 23: Temperature Contour for FBHE

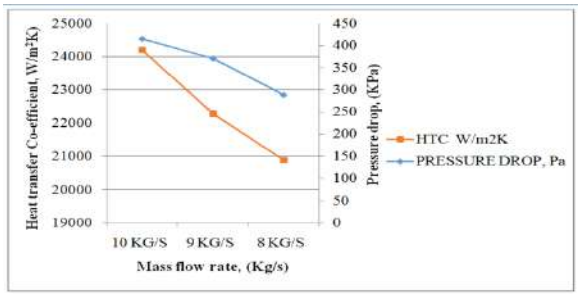

Figure 24; Pressure Drop Vs Mass flow rate for FBHE

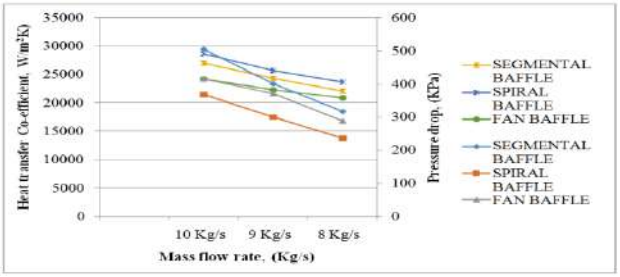

Figure 25:Pressure Drop Vs Mass flow rate for SBHE & FBHE

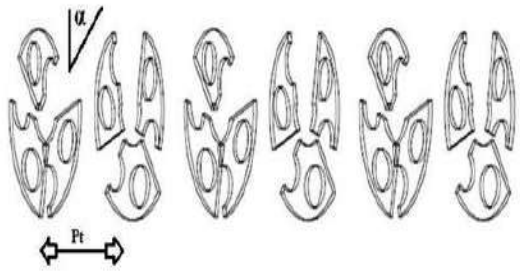

Figure 26: Modification in Fan baffle Geometry

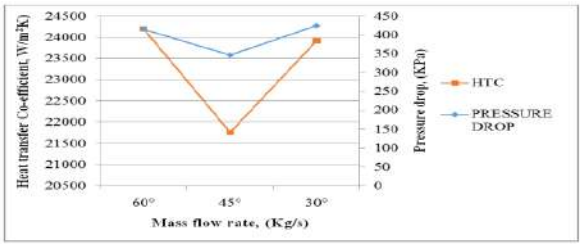

Figure 27: Change in Staggering Angle of Fan Baffle

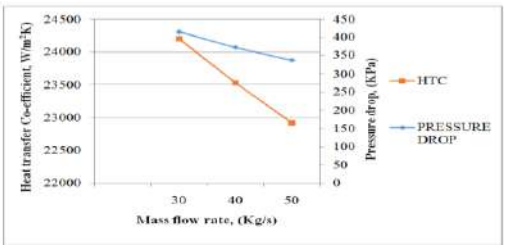

Figure 28: Change in helix pitch of Fan Baffle

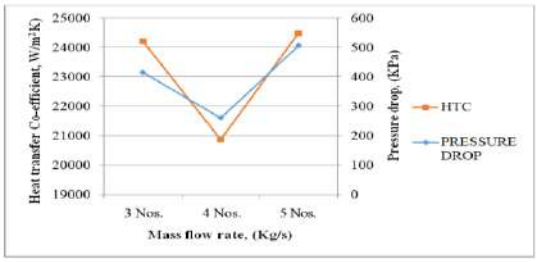

Figure 29:Change in No. of blade in Fan Baffle

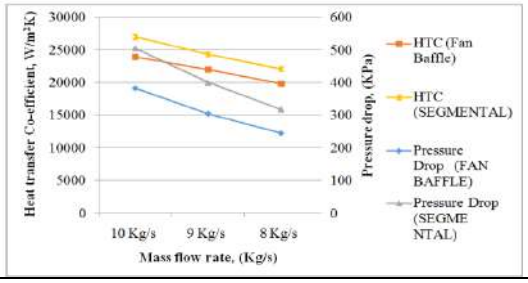

Figure 30: Modified Fan Baffle Geometry

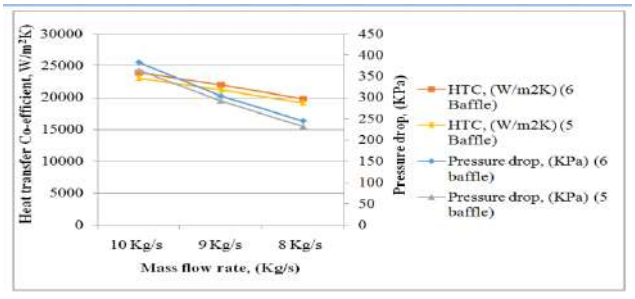

Figure 31: Results by reducing no. of baffle

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RESEARCH ARTICLE

Screening of Anemic Status of Adolescent Girls from Kharar Attending a Private Hospital

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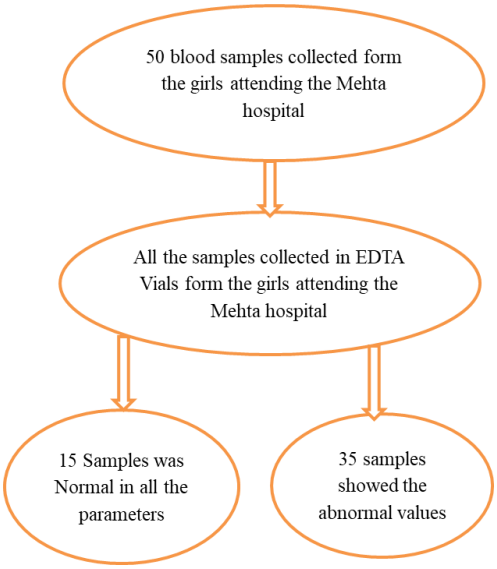
ABSTRACT

Anemia is a haematological disorder. It occurs in every age group mostly in females, as females have a loss of blood and Hb during the period. The normal range of Hb in women is 13-16 in males it varies from 15-18g/dl. If the value is below 11g/dl according to the guidelines it can be considered an anemic condition, or we can say the health condition is not good and doesn't have enough healthy red blood cells RBCs, mostly anemic girls are from poor nutrition backgrounds also have the iron deficiency along with vitamin B12 as well as folic acid deficiencies. In the present study, our main focus was to check the exact cases from the total patient (females) who are attending the OPD (Outpatient Department) to make sure how many girls population is still anemic in this particular area. This study now highlighted the screening and typing of anemia in adolescent girls and also correlated with their nutritional lifestyle. The study has been carried out in the Mehta hospital. New Garden Colony Kharar (Near Civil Hospital Kharar). The health of the girls is reducing day by day the most of the girls are becoming anemic because of low diet plans, and not getting the proper diet. Not consuming a good amount of the food as well as the fruits due to the high cost. Another cause of anemia is the loss of blood during the periods, which is the main cause of blood loss, lack of red blood cells, and high rates of red blood cell distraction. Conditions that may lead to anemia include heavy periods: Adolescent girls are facing this problem during their early age's years when they have just started their teen ages. So, we decided to check the frequency and the total cases from this particular area. The information consent sheet was filled by asking the questions; quest air was filled, and a signature was collected for the patients. Data were collected from adolescent girls between the age group of 10-24 years. The patients were attending the Mehta Hospital, Kharar, Punjab India, from 1st January to 30thMarch 2022. The blood samples were collected from the patients and their Hb report was collected from the patients. The Data was compiled and the statistical analysis was done with the help of SPSS and Excel Microsoft ware, to get the statistical

analysis was done to check out the significant difference in the control as well as the positive values. After analysis, it has been noted that the anemic status of adolescent girls as compared to healthy girls was abnormal. Form 50 samples out of the total tested samples in rural cum small urban areas of Punjab. Out of 50 samples, 35 samples were anemic and 15 were found to be normal. So, the study concluded that girls are more prone to anemic conditions as compared to healthy people.

Keywords: Anemia, significant, hematological, RBCs, Hb.



Graphical abstract of the current research article.

INTRODUCTION

Anemia is the most prevalent hematological condition. When the hemoglobin (Hb) content in the peripheral blood is less than 11 grams per deciliter (gm/dl). Anemia is a common public health and nutrition problem affecting mainly young females, with major consequences on human health. The world health organization recently reported that 1.6 billion of the world population is anemic(1).Anemia is defined as a reduction in hemoglobin (Hb) concentration below a certain threshold, resulting in an inability to satisfy the oxygen demands of tissues. Nutritional anemia is caused by a lack of nutrients required for HB production and erythropoiesis(2). Anemia is a disorder in which the quantity of red blood cells or the amount of haemoglobin in the blood is in sufficient. Haemoglobin is a protein found in red blood cells that allows them to transport oxygen from the lungs to all regions of the body. That is Nutritional anemia develops at a vulnerable stage in the human life cycle, which has been ignored by public health programs for decades. During adolescence, (10-24) years of age, anemia is thought to be the most serious dietary issue (3). There were around 6 million cases worldwide, with approximately 0.36 million fatalities.

The number of confirmed cases in India is steadily growing (4). However, anemia is a global public health problem country with major consequences for human health as well associal and economic development. If anemia is not recognized or treated in a timely manner, it can impair the entire life cycle, especially in women. It has the potential to negatively impact maternal and even sometimes newborn scan be affected health issues, as well as raise the likelihood of post-reproductive impairments (5). Affecting both developed and developing Infancy, childhood, and adolescence are all affected by nutrition. However, the biggest nutritional requirements occur throughout

adolescence. Surprisingly, developing nations account for 84 percent of teenagers (6). Anemia affects 43% percent of children, 38% percent of pregnant women, 29 percent of non-pregnant women, and 29 percent of all women of reproductive age globally, according to a WHO report. Hemoglobin testing is a useful marker for anemia screening and may be done in a variety of ways (7).Because iron is a vital ingredient for the operation of numerous organs, accelerated development, hormonal changes, malnutrition, and the onset of menstrual cycles are the main reasons during this period. The most common cause of megaloblastic anemia in teenage females is due to the vitamin B12 and folic acid deficiency, although vitamin B12 can only be obtained through animal sources (8).

In a report shared by the WHO, half of the world's population is under the age of 18, and nearly a third is between the ages of 10 and 24. Anemia affects 6% of adolescents in industrialist nations and 27% of adolescents in poor countries (5).Adolescence is a crucial period for gaining maximum health and nutritional advantages, which are important at any age. Adolescence is a unique stage of development. During this time, you grow a significant amount of adult height, weight, and bone mass (9).Adolescence is a transitional stage between childhood and maturity. Paediatricians, according to a WHO study, are the primary point of contact for children and adolescents under the age of 19. Iron deficiency is the most prevalent deficit, resulting in iron deficiency anaemia and other health problems (10).The total amount of circulating haemoglobin (total haemoglobin mass, Hb-mass) as well as the volume of plasma (plasma volume, PV) in which it is suspended will determine the concentration of circulating haemoglobin. These characteristics are not commonly examined or assessed in clinical practice, and even with inexperienced hands, estimating them is difficult (11). The present study was to screen out the types of anemia in adolescent girls in kharar area attending the Mehta hospital the Punjab area and to study the correlation due to their food style modifications.

MATERIAL AND METHODS

Data collection the information of the subjects, like age, sex history, diet consumption, of their parents, noted and the nature of her disturbances, and other associated disorders of the suspected adolescent females in the Punjab area were recorded. Sampling area and period of collection, from January to March. Total 50 samples were collected from the suspected adolescent females the age group between 10 to 24 in the Punjab, India, throughout 3 months 1stJanuary to 30th, march, 2022).Collections of blood samples done by the traditional vein puncture method.

Procedure

Which is obtained by the following procedure; Vein puncture should be performed with the care and skill. The vein has to be enlarged by applying a tourniquet in the arm just above the elbow and just tight enough to stop the blood flow. The subject should also be instructed to clench the first to and in building up the blood pressure in the area of the puncture. The materials required for blood collection like disposable syringes and needles, alcohol, gauze or cotton, collection bottle, and so on were assembled. The subject was instructed to sit alongside the table keeping his arm on the table palm upwards. The puncture site was selected carefully after inspecting the arm and the vein of the client felt out where the needle would be introduced. If necessary, the tourniquet was applied to the needle. Mostly median cubital was in preferred and the area was cleaned with cotton, and touched with alcohol. The syringe and needle were removed from the protective wrap. The needle was fixed tightly with the syringe without touching the needle. The syringe was to behold in the right hand and the position the needle was to keep the bevel upward, and then pushed firmly and steadily into the centre of the vein at a 30-40 angle. Processing of Sample all the samples were labelled with the patient's name, age, time, and date of collection accordingly and immediately brought to the laboratory for further processing of the sample. The following test was performed for screening the prevalence of anemia. Haemoglobin estimation, red blood cells count, Erythrocyte sedimentation rate, packed cell volume, red cell indices, red blood cells abnormal morphology study.

Statistical Analysis

The data was compiled and spread in a spreadsheet (Microsoft Excel) and then exported to the data editor of SPSS. Continuous variable was summarized in the form of mean and standard deviations

RESULTS

To present investigation was carried out to study the types of anemic status in adolescent girls in (Punjab) areas. Blood samples were collected along with the case history regarding age, sex, nutritional habits, and other lifestyle were also considered into account.50 samples were collected for a period of 3 months and screened for the prevalence of anemic status by performing follow in the g tests Out of 50 sample studies 35 were found to be positive for the anemic condition.(Table.1),and Fig.1 Represents the abnormal value of the various tests performed and based on the results obtained from the abnormal values of Various age groups suffering from anemia.

RESULTS AND DISCUSSION

In the current study 50 patients, Adolescent girls were studied in the rural Punjab, this study, various information was collected. Anemic and non-anemic Adolescent girls were compared for various factors which are responsible for anemia. Totally 50 (100%) patients refer to the Mehta hospital from these patients 35 (70%) patients were anemic and 15 (30%) were may normal. To verify that the fact present study was carried out to screen out the types of anemia among adolescent girls in Punjab area and to correlate with their life and nutritional style by performing various tests. Such as hemoglobin estimation, Red Blood cells count, Erythrocyte Sedimentation Rate, Hematocrit determination, Blood cell indices, and study of abnormal morphological red cells. Out of 50 samples processed 35 samples showed the prevalence of the anemic condition and the remaining 15 samples were normal and the persons may be healthy due to their maintaining of good diet and hygienic condition. Among the 35 anemic sample, most of the adolescent girls were suffering from an irregular menstrual cycle may be due to improper hematopoiesis and hormonal deficiencies and, various associated factors. Improper hematopoiesis and hormonal deficiency may by ds to anemic the condition we that are already reported in previous studies. Some of the girls are suffering from prolonged bleeding during their menstruation cycle, some were experienced cyst (POCD), and with discharge. Males have greater hemoglobin levels than females because prostaglandins (PGE) aid erythropoiesis both directly (PGE1) and indirectly (cyclic AMP) (PGE2). Androgens increase or facilitate the creation of erythropoietin in erythroid stem cells, which boosts its function. Estrogens, on the other hand, prevent erythropoietin from doing its job.

Regarding the RBC count, in some girls their red cell count remains normal but, many reticulocytes were observed, due to the maturation of red blood cells during the process of erythropoiesis. Elevated levels of ESR are estimated in the screened sample. It may be due to temporal arthritis, joint pain, shoulder pain or neck, and various anemic states. In previous studies, the authors showed that prevalence of Anemia in adolescent girls was reported. MCV and MCHC values are decreased in most of the girls may be due to Microcytosis associated with hypochromia (low concentration of hemoglobin in red cells). It is seen in iron deficiency anemia, Hemoglobinopathies, and thalassemia. And finally, During the inquiry, several distinct red blood cell abnormalities such as spherocytes, target cells, sickle cells, elliptocytes, Macrocytes, Microcytes, and others are graded. This abnormal morphology is due to conditions like iron deficiency, folate or B12 deficiency, liver disease, the hyperactivity of bone marrow, Glucose 6- phosphatase deficiency, and red cells membrane defect.

DISCUSSION AND CONCLUSION

Anemia occurs when the number of red blood cells or their capacity to carry oxygen is insufficient to meet physiological needs. Anemia can be caused by a deficiency of vitamin A, vitamin B12, folate, or iron, among other things; chronic inflammation; parasite infection; and a hereditary illness (12). Anemia can be caused by a reduction in

erythrocyte production or an increase in blood loss due to hemolysis, hemorrhage, or both. Nutritional, viral, and genetic variables all have a role. Anemia is a sign of socioeconomic inequality within and between groups, with the poorest and least educated people being the most prone to anemia and its consequences (13). Anemia due to nutritional inadequacy is a worldwide problem, although it affects underdeveloped countries more severely. The total prevalence of anemia in this research was 48.63 percent, reflecting the burden of anemia among a group of teenage girls attending a tertiary care hospital in a rural context. Adolescence is a phase of fast development that includes both physical and mental changes. During this time, a person may experience emotional, sexual, social, and educational issues. Furthermore, their poor eating habits and low socioeconomic status leave them susceptible to a variety of nutritional morbidities (14).

CONCLUSION AND RECOMMENDATION

The current study was carried out to study the incident report and the anaemic status of adolescent girls in rural of (Punjab) area. 50 blood samples were collected, immediately by following the standard procedure for analysis. Out of 50 samples processed 35 were positive for anaemic conditions. The adolescent female group at the age of 10 also positive reached anaemia. Because of their poor nutritional status and food style modification. Most females are suffered from iron deficiency anemia (IDA). It may be due to their physiological cycles, economic status, decreased iron absorption, iron loss, and various associated factors. The cheapest medicine for anemia sufferers is ferrous sulphate 200 mg, which contains 60 mg of elemental iron. Anemia can be successfully treated by taking proper medications and well balance nutritional diet consumption regularly. Blood transfusions and bone marrow transplants are frequently required when anemia is severe. Some drugs are recommended to encourage the production of new blood cells in the bone marrow. This is beneficial in the treatment of a plastic anaemia and leukaemia according to the situation in the current study. The following suggestion will be useful in controlling as well as preventing anemia.

The good news is that anemia can be successfully treated and even prevented. Depending on the type of anemia the patients suffer, treatment may differ. This often entails taking iron supplements, such as ferrous sulphate, to compensate for a shortage of iron in the diet. It's taken twice or three times a day as tablets. Foods contain two forms of iron: heme iron and non-heme iron. Only animal foods, such as cattle, lamb, meats, and some marine foods, contain vitamin B12 (heme iron). Present study confirms that there are lots of girls who are deficient level of Hb and we required to delivered the talks and the research related to the current social issues. So, the current study is to confirm the real population of the girls with iron deficiencies. Do that the necessary action or the programmes can be run for their health. This study will be helpful to save the girls with problems related the anemia and blood issues. By finding the real numbers of the cases the necessary action can be taken, these studies can be considered for the better public health concern.

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Table.1. Abnormal Values of patients Suffered from Anemia

Age Group	Hb g/dL	RBC (million Cells/cu.mm)	ESR (mm/hr)	PVC (%)	MCV (f1)	MCH (pg)	MCHC (%)	Abnormal Red cells
10(n=3)	10-13	3.96- 5.76	15-30	30-39	72- 79	23-30	32-36	Microcytes.
13 (n=1)	6.6	2.50	38	20	82.4	26.4	33.4	Microcytes, sickle cells
14(n=3)	9.6-11.5	4.11-4.60	14-24	30-33	71.5-82.2	22.0-28.0	30.7-35.3	Microcytes
15(n=1)	9.34	2.15	11	20	71	22	30	sickle cells microcytes.
17(n=4)	7.5-12.2	3.7-12.2	8-30	2741-	72-87.5	20-25	27-29.6	Microcytes, sickle cells
18(n=5)	9.9-12.1	4.1-4.42	12-56	31.7-41	79.3-86	24.7-27	22-36.6	Microcytes, sickle cell, teardrop RBC
19(n=4)	7.9-12.6	3.8-12.6(n)	31-52	28-50	73-82.5	20-28	28-33.3	Microcytes, sickle cells, macro. Poikillocytes

20(n=5)	7.2-13	3.6-4.38(n)	30-60	26-41	72-88.6	20-29	26-32.7	Sickle cell, microcytes, elliptocytes
21(n=3)	8.2-15	3.8-5.4	6- 36	29-50	76-92	21-27.7	28-30	Macrocytes, sickle cells, elliptocytes
22(n=3)	9—11.2	3.4-4.0(n)	32-48	32-38	79-82	23-24	25-29	Poikillocyte, macrocytes, target cell, ovalocytes
23(n=2)	11.5-13	4.7-5.0(n)	26-41	39-44	82-88	25-26	25-29.5	Microcytes
24(n=1)	7	3.6-4.0(n)	12	26	83	24	29	Macrocytes, sickle cells.

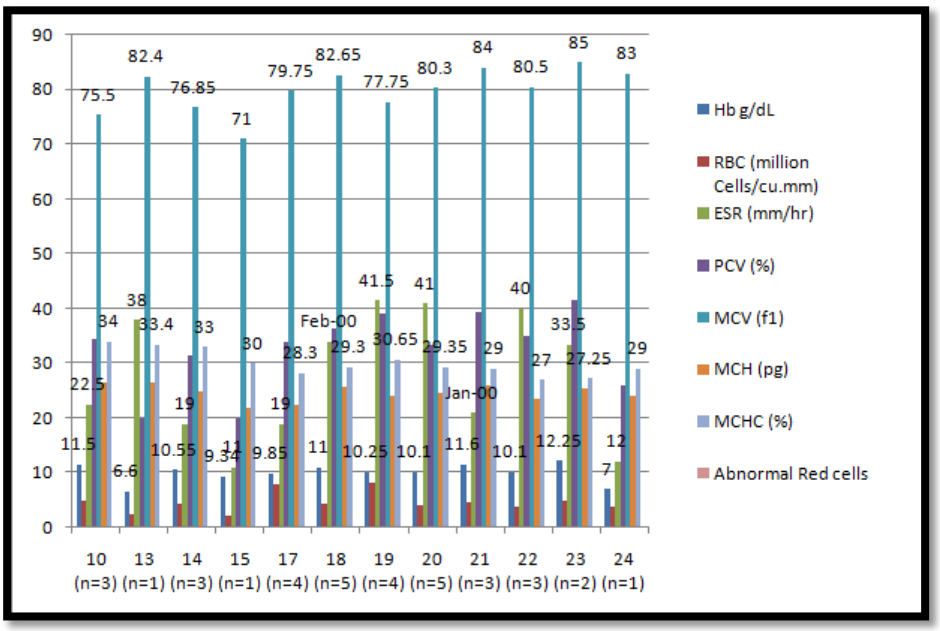

Fig. 1. Abnormal values of various age groups suffered from Anemia

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RESEARCH ARTICLE

In silico Identification of Murine Doubleminutes-2-P53 Inhibitors for the Treatment of Cancer

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ABSTRACT

To design and synthesis of lead inhibitors that block the MDM2-p53 interaction has become a attractive strategy to activate p-53 for the treatment of cancer and other human disease. The study revealed that a number of lead molecule inhibitors of MDM2-p53 interaction identified as a transcriptional inhibition and impairs the p-53 function. Synthetic indol-3-yl glyoxylamides were identified as a new group of microtubule destabilizing anticancer agents, with the most active derivative N-(pyridine-4-yl)-[1-(4-chlorobenzyl)indol-3-yl]glyoxylamide (Indibulin, D-24851,) has been reported to inhibit the growth of multidrug resistant tumors both invitro and *in vivo*. Indole-3-glyoxylamides are an attractive lead series for continuing development as potential therapeutic agents. A number of Indole-3- glyoxylamides have previously been reported as tubulin polymerization inhibitors; exert a cytotoxic effect against multiple cancer cell lines. Recently, substitutedindol-3-ylglyoxylamides were found to exhibit anticancer, antiprion and anti HIV activity. The present study aims to focus on the chemistry of Indole-3-glyoxylamide derivatives, their potential activities against, 1RV1 inhibitors, biological activity and in-silico screening of designed compounds by Autodockvina. The study revealed that a number of Indole-3-glyoxylamide derivatives have better binding interaction than the standard drug. Molinspiration software was used to analyse 'Lipinski Rule of Five' and drug likeness properties. Among all the designed ligands the lead molecules (IG-5, IG-15, IG-18, IG-21, IG-22, IG-25,IG-27, IG-31, IG-45, IG-47, IG-52, IG-55, IG-56,IG-61,IG-65,IG-66) showed more binding energy (6.7-6.9kcal/mol).these results highlights the identification of a new class of MDM2-P-53 inhibitors that have potential to be more efficacious than indibulin, to treat cancer and other human diseases. In future we planned to synthesis these ligand and to screen for their *in vitro* anticancer activity.

Keywords: MDM2-p-53.Indol-3yl-glyoxylamide, Docking, Lipinski rule.

INTRODUCTION

P-53, also known as TP53 or tumor protein (EC :2.7.1.37) is a gene that codes for a protein that regulates the cell cycle and hence functions as a tumor suppression. It is very important for cells in multicellular organisms to suppress cancer. P53 has been described as "the guardian of the genome", referring to its role in conserving stability by preventing genome mutation (Strachan and Read, 1999). The name is due to its molecular mass: it is in the 53 kilodalton fraction of cell proteins. It plays an important role in cell cycle control and apoptosis. Defective p53 could allow abnormal cells to proliferate, resulting in cancer. As many as 50% of all human tumors contain p53 mutants. In normal cells, the p53 protein level is low. DNA damage and other stress signals may trigger the increase of p53 proteins, which have three major functions: growth arrest, DNA repair and apoptosis (cell death). The growth arrest stops the progression of cell cycle, preventing replication of damaged DNA. During the growth arrest, p53 may activate the transcription of proteins involved in DNA repair. Apoptosis is the "last resort" to avoid proliferation of cells containing abnormal DNA. The cellular concentration of p53 must be tightly regulated. While it can suppress tumors, high level of p53 may accelerate the aging process by excessive apoptosis. The major regulator of p53 is Mdm2, which can trigger the degradation of p53 by the ubiquitin system.

p53 is a transcriptional activator, regulating the expression of Mdm2 (for its own regulation) and the genes involved in growth arrest, DNA repair and apoptosis (Fig.1). Some important examples are listed below.

- Growth arrest: p21, Gadd45, and 14-3-3s.
- DNA repair: p53R2.
- Apoptosis: Bax, Apaf-1, PUMA and NoxA.

Role of P-53 in Endometrial Cancer

Endometrial carcinomas are the most common malignant tumours of the female genital tract. The tumours are sub-classified into two types; type I, EC and type II, SC. This classification is based on epidemiological, clinical and pathological features and molecular findings. SC account for a minority of endometrial carcinomas and do not seem to be associated with estrogenic risk factors. In contrast, EC, the most common type, is considered to be related with excess estrogen exposure. Endometrial cancer has been classified into type-I and type-II based on clinical, histopathological, and molecular finding. Type-I endometrial cancer mainly consists of endometrioid cancer that is considered to develop in an estrogen-dependent manner, arises in atypical endometrial hyperplasia, occurs in premenopausal or perimenopausal women, and is associated with a favorable prognosis. Genetically, in type-I endometrial endometrioid carcinoma, dysfunction of DNA mismatch repair genes and gene mutations in PTEN and KRAS have been shown to be associated with carcinogenesis of the endometrium. In contrast, type-II endometrial cancer mainly consists of serous cancer that is thought to be de novo carcinogenesis developing directly from the atrophic endometrium, occurs in postmenopausal women, and is associated with a poor prognosis. Genetically, TP53 mutation, HER2/neu, and loss of E-Cadherin are more frequent in type-II than type-I endometrial cancer. Dysfunction of p53 in endometrial cancer is closely associated with TP53 mutation. TP53 mutation is detected in about 25% of all endometrial cancer patients. The frequency of TP53 mutation in type I endometrial cancer is about 10–40%, whereas that in a type II endometrial cancer is about 90%. Schulthei et al. analyzed TP53 mutations in a total of 228 cases of endometrial carcinomas, including 186 cases of endometrioid carcinomas and 42 cases of serous carcinomas. Design of small-molecule inhibitors (MDM2 inhibitors) to block the MDM2–p53 protein–protein interaction has been pursued as a new cancer therapeutic strategy. In recent years, potent, selective, and efficacious MDM2 inhibitors have been successfully obtained and seven such compounds have been advanced into early phase clinical trials for the treatment of human cancers.

MDM2-p53 interaction for cancer therapy

MDM2 plays a primary role in inhibition of the p53 tumor suppressor function and antagonizes p53 through their direct interaction, blockade of the MDM2–p53 protein–protein interaction would liberate p53 from MDM2, thus restoring the tumor suppressor function of wild-type p53. Agents designed to block the MDM2–p53 interaction may

have a therapeutic potential for the treatment of human cancers retaining wild-type p53. In cells, MDM2 and p53 regulate each other mutually through the autoregulatory feedback loop shown in Figure.2 The autoregulatory feedback loop of the p53–MDM2 interplay operates as follows: upon activation, p53 transcribes MDM2, leading to an increase of MDM2 mRNA and protein and in turn, MDM2 protein binds to p53 directly through their N-termini and inhibits p53 function through three major mechanisms: (1) upon binding, MDM2 ubiquitinates p53 by functioning as an E3 ligase promoting proteasomal degradation of p53 interaction of MDM2 with p53 blocks the binding of p53 to its targeted DNA, rendering p53 ineffective as a transcription factors MDM2 promotes export of p53 out of the cell nucleus, leaving p53 inaccessible to targeted DNA and reducing its transcriptional ability Through these three inhibitory mechanisms, MDM2 functions as an effective antagonist of wild-type p53.

P-53 Signalling Pathway

The p53 protein has a central role in eliciting the cellular responses to various cellular stresses, including DNA damage. Following cellular stress, p53 is stabilized and regulates the expression, localization and activity of genes that mediate DNA repair, cell-cycle arrest, senescence and apoptosis (Figure:3). This multitasking is important for mediating the cellular responses to many standard stress inducing cancer therapies. Studies in model systems suggest that enhancement or reactivation of p53 activity in cancer cells, either in combination with stress inducing therapies, or alone, could improve the efficacy of cancer therapies. It acts as an important defense mechanism against cancer onset and progression, and is negatively regulated by interaction with the on coprotein MDM2. In human cancers, the TP53 gene is frequently mutated or deleted, or the wild-type p53 function is inhibited by high levels of MDM2, leading to down regulation of tumor suppressive p53 pathways. Thus, the inhibition of MDM2-p53 interaction presents an appealing therapeutic strategy for the treatment of cancer. However, recent studies have revealed the MDM2-p53 interaction to be more complex involving multiple levels of regulation by numerous cellular proteins and epigenetic mechanisms, making it imperative to re-examine this intricate interplay from a holistic viewpoint. This review aims to highlight the multifaceted network of molecules regulating the MDM2-p53axis to better understand the pathway and exploit it for anticancer therapy.

METHODOLOGY

In silico Molecular Docking Studies

Molecular Descriptors Analysis: Molecular descriptors are the terms that characterize specific information about a compound or drug molecule. They are the numerical values associated with the chemical constitution for correlation of chemical structure with various physical properties, chemical reactivity or biological activity.

Analysis of Lipinski's rule of five: Lipinski's rule of five also known as the Pfizer's rule of five is a rule of thumb to evaluate drug likeness, or to determine if a chemical compound with a certain pharmacological or biological activity has chemical properties and physical properties that would make it a likely orally active drug in humans.. The analysis was performed by using molinspiration software and the results are shown in the Table: 1

Prediction of drug likeness: Drug likeness is a concept used in drug design for how ―drug like‖ a substance is. It is estimated from the molecular structure before the compound is even synthesized and tested. Table: 2 shows the analysis of drug likeness of the designed molecules.

Molecular descriptors of designed derivatives: Molecular descriptors of selected lead molecules generated by using ACD ChemSketch and the results are shown in Table: 3

Rational Drug Design: Indibulin is a new generation of anticancer compound with anti- mitotic properties. Unlike many anti-mitotic agents, it does not exert peripheral neuropathy

Pharmacophore Analysis

The computationally designed 2-aryl indol-3-yl glyoxylamides (IG-1 to IG-70) compounds were used for molecular and biochemical characterization. The pharamcophore analyses of these compounds were studied with respect to aromatic and Heterocyclic amine substituents. The chemical structures of these new compounds were drawn using ChemDraw Ultra 8.0. All the designed compounds show zero violations of the rule of 5 which indicates drug likeness properties and good bioavailability. Among these, several aryl/ heteroaryl substituted indolylglyoxyamides have shown good inhibition towards the tubulin polymerization.

Identification of Protein structure

The crystal structure of MDM2 receptor bind p53 tumor suppressor protein (PDB ID: 1RV1) Figure:4 shows over expression in transcriptional inhibition and impairs the p53 function, this characteristic shows inhibition of further downstream pathways. The new active sites of MDM2 receptor bind p53 and PBR with nonpolar integration of valid amino acids were predicted using Q-site finder [www.bioinformatics.leeds.ac.uk/qsitefinder]. The activity of 3D structure is assumed as a ligand binding site and the whole protein structure itself is used as ligand binding site. The hydrophobic nature of active site amino acids were calculated using RMSA shows geometry accuracy of target protein structures. The resultant protein structures helps for rigid docking against the designed compounds(IG-1 to 70) The docking study was performed using Auto Dock Tools (ADT) v 1.5.4 program to create grid maps of different grid points for covering ligand binding pockets such as active site amino acids. Using molecular modeling and simulation algorithms such as Lamarckian genetic algorithm helps for molecular simulation and docking. From this, the lowest energy conformations were regarded as the best binding conformations.

Chem Bio Draw Ultra

The structures of all the ligands were prepared using Chem Bio Draw Ultra 8.0, software for drawing chemical structures developed by Cambridge Pvt. Ltd

Protein selection

The selected protein which has the specific biological activity was downloaded in the PDB format using respective PDB ID from Protein Data Bank (www.pdb.org). PDB is single, global archive for information about 3D structure of biological macromolecules as determined by NMR spectroscopy, cryo electron microscopy, X-ray crystallography. The X-ray crystal structures of MDM2 P53 (PDB: 1RV1) was retrieved from RCSB Protein data bank.

Preparation of protein

A typical PDB structure file is made up of heavy atoms and includes a co-crystallised ligand, water molecules, metal ions and cofactors. Structures which are multimeric, may need to be reduced to a single unit. PDB structures may have some missing information on connectivity that must be assigned with bond orders and formal charges. This was done using the Protein Preparation wizard. According to OPLS-AA force field, partial atomic charges were assigned.

Ligand preparation

The structures that are docked must be good representation of the actual ligand structures as they are docked in a protein-ligand complex in order to give the best result. For this the structures must show following conditions, • Must be prepared in PDB format and must have all hydrogens. •Must consist of a single molecule that has no covalent bonds to the receptor, with no accompanying fragments such as counter ions and solvents.•Must have realistic bond lengths and bond angles.

Docking

After making the protein and ligand to pdbqt format, the grid was made to maximum. Then docking was done to obtain the docking score. Table: 4

Visualizing docking results PyMol was used for visualizing ligand-protein interaction

***In silico* docking results against MDM2-P53 (Lead compounds) Table: 5**

a) Compounds that are unsubstituted on one of the phenyl ring at 2nd position of indole and 3rd position of glyoxylamide chain and possessing electron releasing groups (OCH3, OH) on the other ring showed least binding energy.

b) Electron withdrawing group (Cl) on phenyl ring attached at 2nd position of indole showed moderate activity.

c) Sulphanillic acid and sulphonamide present in glyoxylamide side chain showed least binding energy.

d) The other derivatives are compared with reference standard as may be affected by the electron withdrawing or releasing substituents on phenyl ring at 2nd position of indole and glyoxylamide side chain.

e) According to docking analysis the most active ligand showed good binding interactions in terms of hydrogen bond and hydrophobic interactions with the residues of proteins amino acids. So, all the compounds exhibited a good docking score which were agreed and supported to the in- vivo anti-cancer of these compounds.

In silico Docking Results of Lead Compounds against MDM2-P53 (BY AUTODOCK VINA) Figure: 5

RESULT AND DISCUSSION

In the present study, a series of new appropriately 2-aryl indol-3- ylglyoxylamides were computationally designed and energy minimized. The molecular properties were calculated from suitable computational tools. Furthermore, all molecules were docked to the active site of MDM2-P53 receptor using the docking program Auto dock. Most of the designed compounds showed high docking score against MDM2-P53. The least binding energy were found to be in good agreement with the pharmacological results. These ligands were investigated for drug like properties by calculating Lipinski's rule of five using molinspiration. All of the derivatives showed zero violations of the rule of 5 which indicates good bioavailability.

CONCLUSION

1. A series of new appropriately 2-aryl indol-3- ylglyoxylamides were computationally designed and energy minimized. The molecular properties were calculated from suitable computational tools.
2. These ligands were investigated for drug like properties by calculating Lipinski's rule of five using molinspiration. All of the derivatives showed zero violations of the rule of 5 which indicates good bioavailability
3. The active crystal structures of MDM2 receptor bind p53 tumor suppressor protein was interacted with pharmacophores -2-aryl indol-3- ylglyoxylamides IG-1 to IG-70) using molecular docking.
4. The docking of MDM2 receptor bind p53 tumor suppressor protein with newly synthesized ligands exhibited well established bonds with one or more amino acids in the receptor active pocket. *In silico* studies revealed that all the synthesized molecules showed good binding energy toward the target protein ranging from -5.6 to -6.9 kcal/mol.
5. The substituted phenyl ring at C-2 position of indoleglyoxylamide skeleton may enhance their binding energy.
6. Aromatic/ heterocyclic 5- membered and 6-membered amine derivatives substituted at C-3 position of indol-3yl-glyoxylamide.
7. The *in silico* docking study of -2-aryl indol-3-yl glyoxylamides were revealed that the compound IG-5,IG-15, IG-21, IG-22, IG-25, IG-31, IG-45, IG-47, IG52, IG-55 AND IG-61, IG-65,IG-66 found to bind efficiently with 1RV1 protein.
8. Among all the designed ligands the lead molecules (IG-5, IG-15, IG-18, IG-21, IG-22, IG-25,IG-27, IG-31, IG-45, IG-47, IG- 52, IG-55, IG-56,IG-61,IG-65,IG-66) showed more binding energy (6.7-6.9kcal/mol).these results highlights the identification of a new class of MDM2-P-53 inhibitors that have potential to be more efficacious than indibulin, to treat cancer and other human diseases. In future we planned to synthesis these ligand and to screen for their invitro anticancer activity

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Table 1. Molecular Properties

COMP	LogP	TPSA	MW	No of Hydrogen bond acceptor	No of Hydrogen bond donor	Violation	No of Rotatable bond	Molar volume
IG-5	2.78	122.12	419.46	7	4	0	5	348.93
IG-15	2.30	142.35	435.46	8	5	0	5	356.99
IG-18	2.32	95.08	357.37	6	3	0	4	310.07
IG-21	4.05	107.78	385.38	7	2	0	5	329.59
IG-22	4.72	107.78	419.82	7	2	0	5	343.08
IG-25	2.74	167.45	464.60	10	4	0	6	372.01
IG-27	3.15	120.68	386.37	8	2	0	5	325.38
IG-31	4.14	71.19	370.41	5	2	0	5	331.75
IG-45	2.25	162.58	451.46	6	1	0	5	369.96
IG-47	2.65	115.31	373.37	7	4	0	4	318.09
IG-52	5.44	61.96	409.27	4	2	0	4	333.28
IG-55	3.46	122.12	453.91	7	4	0	5	362.46
IG-56	4.68	99.26	418.89	6	3	0	5	346.75
IG-61	3.16	87.98	355.40	5	4	0	4	317.50
IG-65	1.86	148.15	434.48	8	6	0	5	360.22
IG-66	3.07	125.28	399.41	7	5	0	5	344.50

Table 2 . Bioactivity

Comp	GPCR	Ion channel	Kinase Inhibitor	Nuclear receptor	Protease inhibitor	Enzyme inhibitor
IG-5	-0.02	-0.18	0.14	-0.39	-0.03	0.11
IG-15	0.01	-0.14	0.16	-0.27	-0.02	0.15
IG-18	0.18	-0.03	0.36	-0.11	-0.11	0.14
IG-21	-0.07	-0.14	0.03	-0.28	-0.29	-0.08
IG-22	-0.07	-0.40	0.01	-0.29	-0.32	-0.11
IG-25	-0.13	-0.20	0.00	-0.43	-0.13	0.02
IG-27	0.04	-0.09	0.22	-0.34	-.21	0.00
IG-31	0.02	-0.17	0.13	-0.22	-0.23	-0.04
IG-45	0.03	-0.26	0.18	-0.37	-0.06	0.13
IG-47	0.24	-0.06	0.43	-0.20	-0.11	0.13
IG-52	0.66	-0.11	0.15	-0.23	-0.22	-0.02
IG-55	-0.03	-0.18	0.11	-0.39	-0.07	0.08
IG-56	0.07	-0.11	0.11	-0.09	-0.18	0.03
IG-61	0.11	-0.05	0.26	-0.26	-0.10	0.10
IG-65	0.01	-0.13	0.19	-0.40	0.62	0.17
IG-66	0.11	-0.05	0.20	-0.11	-0.07	0.14

Table 3. Molecular descriptors analysis

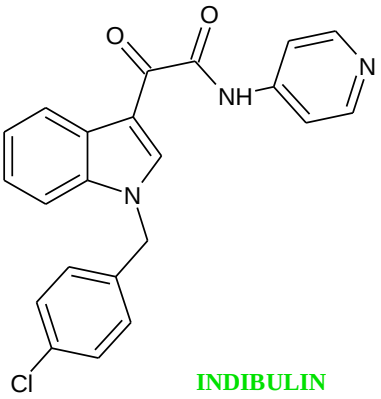
Compound code	**Molar refractivity (cm3)**	**Molar volume (cm3)**	**Refractive index**	**Parachor (cm3)**	**Polarizability (10-24 cm3)**	**Surface tension (dyne/cm)**
IG-5	113.23 ± 0.4	288.6 ± 3.0	1.713 ± 0.02	842.1 ± 6.0	44.88 ± 0.5 10^{-24}	72.4 ± 3.0
IG-15	114.76 ± 0.4	287.0 ± 3.0	1.731 ± 0.02	857.3 ± 6.0	45.49 ± 0.5 10^{-24}	79.5 ± 3.0
IG-18	102.33 ± 0.3	251.3 ± 3.0	1.749 ± 0.02	737.7 ± 4.0	40.56 ± 0.5 10^{-24}	74.2 ± 3.0
IG-21	108.90 ± 0.3	271.4 ± 3.0	1.734 ± 0.02	784.0 ± 4.0	43.17 ± 0.5 10^{-24}	69.5 ± 3.0
IG-22	113.79 ± 0.3	283.4 ± 3.0	1.735 ± 0.02	819.8 ± 4.0	45.11 ± 0.5 10^{-24}	70.0 ± 3.0
IG-25	119.26 ± 0.4	300.4 ± 3.0	1.724 ± 0.02	899.1 ± 6.0	47.28 ± 0.5 10^{-24}	80.2 ± 3.0
IG-27	106.99 ± 0.3	264.7 ± 3.0	1.742 ± 0.02	778.1 ± 4.0	42.41 ± 0.5 10^{-24}	74.6 ± 3.0
IG-31	109.03 ± 0.3	283.6 ± 3.0	1.695 ± 0.02	785.2 ± 4.0	43.22 ± 0.5 10^{-24}	58.7 ± 3.0
IG-45	116.28 ± 0.4	285.4 ± 3.0	1.749 ± 0.02	872.5 ± 6.0	46.10 ± 0.5 10^{-24}	87.2 ± 3.0
IG-47	113.05 ± 0.3	269.0 ± 3.0	1.781 ± 0.02	820.6 ± 4.0	44.81 ± 0.5 10^{-24}	86.5 ± 3.0
IG-52	112.14 ± 0.3	283.5 ± 3.0	1.721 ± 0.02	800.2 ± 4.0	44.45 ± 0.5 10^{-24}	63.4 ± 3.0
IG-55	118.05 ± 0.4	300.5 ± 3.0	1.714 ± 0.02	879.2 ± 6.0	46.80 ± 0.5 10^{-24}	73.2 ± 3.0
IG-56	114.18 ± 0.3	284.1 ± 3.0	1.736 ± 0.02	826.5 ± 4.0	45.26 ± 0.5 10^{-24}	71.6 ± 3.0
IG-61	106.59 ± 0.3	261.9 ± 3.0	1.748 ± 0.02	754.3 ± 4.0	42.25 ± 0.5 10^{-24}	68.7 ± 3.0
IG-65	116.84 ± 0.4	290.8 ± 3.0	1.736 ± 0.02	870.0 ± 6.0	46.32 ± 0.5 10^{-24}	80.0 ± 3.0
IG-66	113.52 ± 0.3	274.4 ± 3.0	1.765 ± 0.02	816.5 ± 4.0	45.00 ± 0.5 10^{-24}	78.3 ± 3.0

Table 4. *In silico* Docking Results against MDM2-P53 Affinity (Kcal/mol)

R_2	R_1-COCH3	P-OH	P-NO_2	P-OCH_3	2,6Dihydroxy	P-Cl	P-NH_2
	IG1-10	IG11-20	IG21-30	IG31-40	IG41-50	IG51-60	IG61-70
Aniline	-5.6	-6.4	-6.8	-6.8	-6.6	-6.4	-6.8
P-Cl aniline	-5.7	-6.4	-6.7	-6.1	-6.7	-6.7	-6.4
P- OH aniline	-6.3	-6.4	-6.6	-6.3	-6.7	-6.4	-6.5
Sulphanilic acid	-6.5	-6.1	-6.6	-6.3	-6.5	-6.0	-6.6
Sulphanilamide	-6.9	-6.5	-6.8	-6.4	-6.7	-6.7	-6.8
P-aminobenzoicacid	-6.6	-6.5	-6.4	-6.5	-6.6	-6.5	-6.7
2-aminopyridine	-6.6	-6.4	-6.8	-6.4	-6.7	-6.3	-6.3
4-amino pyridine	-6.3	-6.6	-6.5	-6.1	-6.6	-6.3	-6.1
2-amino thiazole	-6.4	-6.1	-6.3	-6.2	-6.4	-6.1	-6.1
Piperazinamine	-6.6	-6.3	-6.2	-6.4	-6.3	-6.1	-6.3
IDB standard	-6.8						

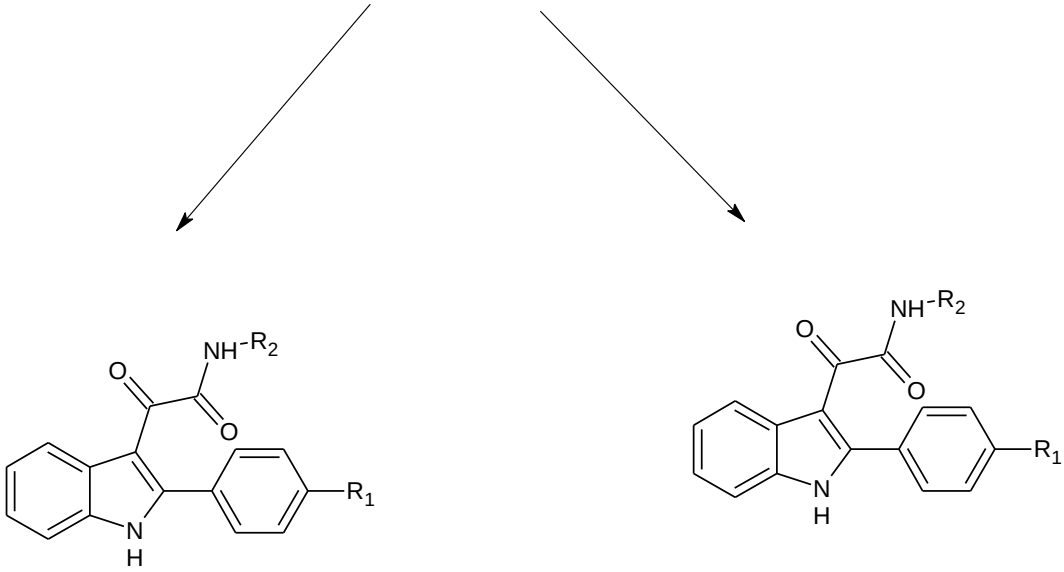
Table 5. *In silico* docking results against MDM2-P53 (Lead compounds) Table: 5

SI.NO	COMPOUND CODE	BINDING AFFINITY
1	IG-5	-6.9
2	IG-15	-6.5
3	IG-18	-6.6
4	IG-21	-6.8
5	IG-22	-6.7
6	IG-25	-6.8
7	IG-27	-6.8
8	IG-31	-6.8
9	IG-45	-6.7
10	IG-47	-6.7
11	IG-52	-6.7
12	IG-55	-6.7
13	IG-56	-6.5
14	IG-61	-6.8
15	IG-65	-6.8
16	IG-66	-6.7



INDIBULIN

2-[1-(4-chlorobenzyl)-1*H*-indol-3-yl]-2-oxo-*N*-(pyridin-4-yl)acetamide



R2-Aryl

R2-Heteroaryl

Structure of indibulin and modification of indibulin

R1	P-OH, P-Cl, P-NO_2, P-NH_2, P-OCH_3, 2,6Dihydroxy Acetophenone
R2	**Aryl**-Aniline,4-chloro,p-OH aniline suphanilicacid, sulphanilamide,p-Amino phenol, p-amino benzoicacid. **Heteroaryl**- 2-Amino pyridine, 4-Amino pyridine & 2- Amino thiazole

Rational Drug Design

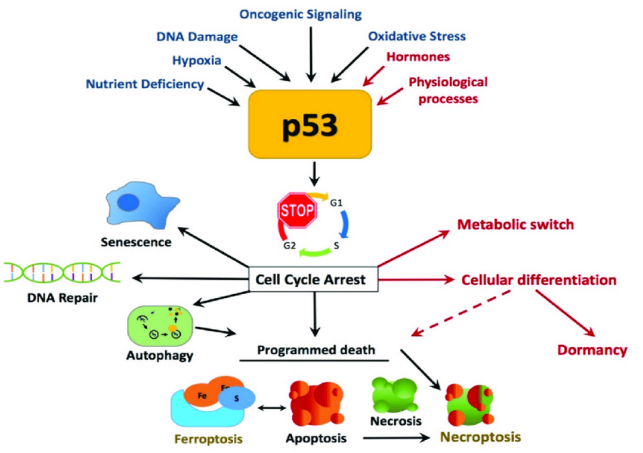


Figure 1. Cell Cycle arrest

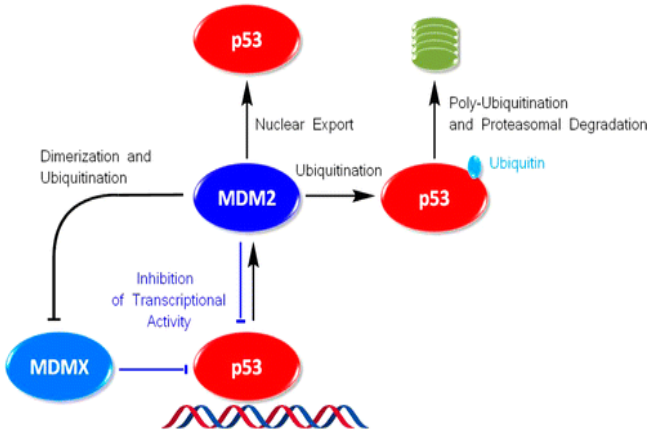


Figure 2. Auto regulatory

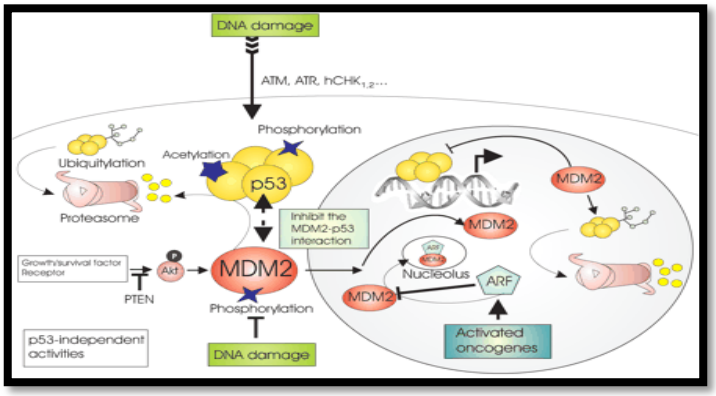


Figure 3. Signaling Pathway

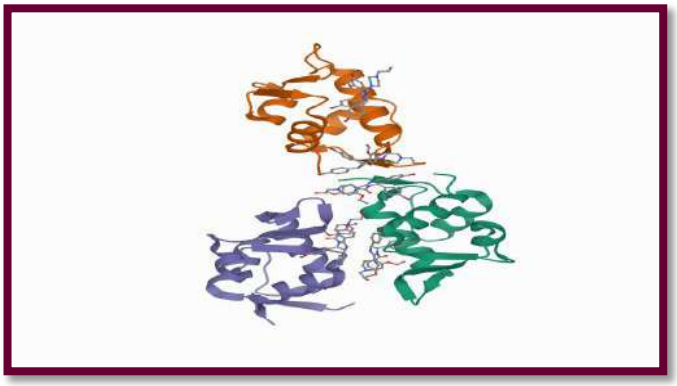
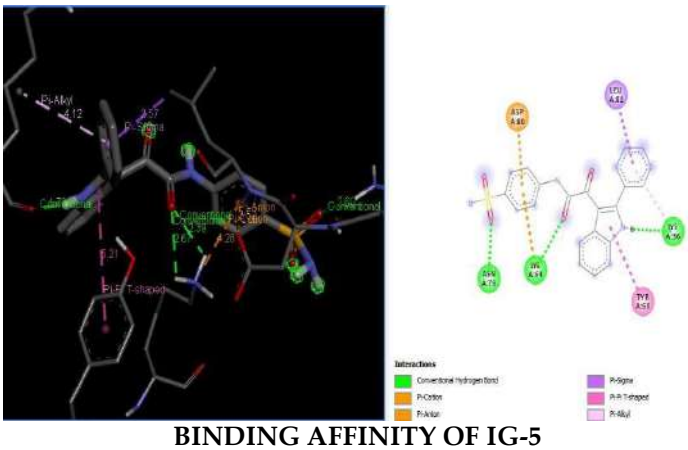
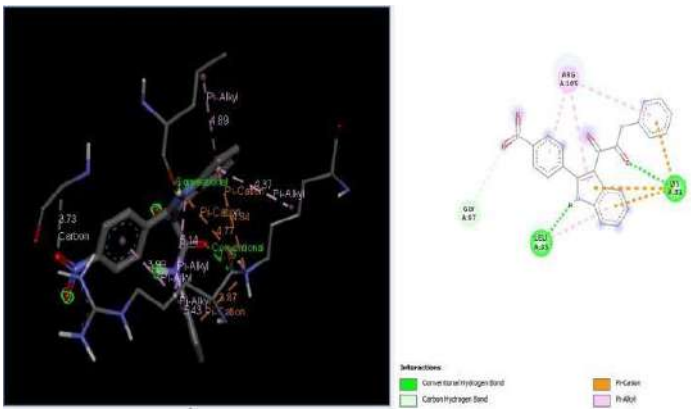


Figure: 4 (1RV1)



BINDING AFFINITY OF IG-5



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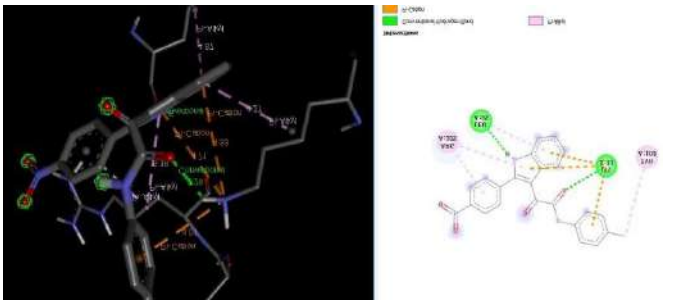

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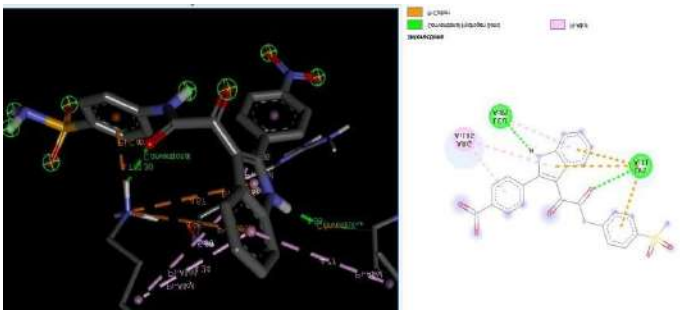

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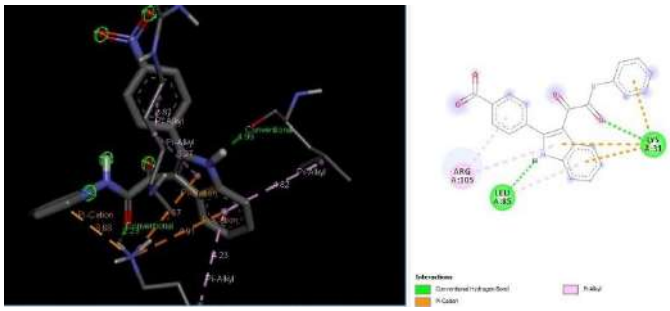

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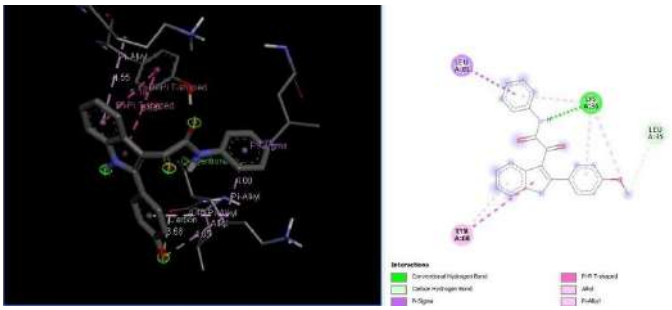

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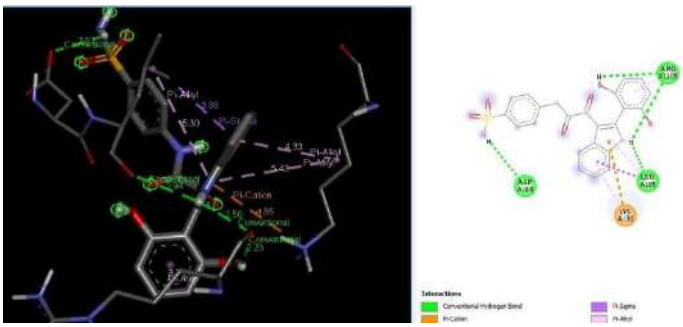

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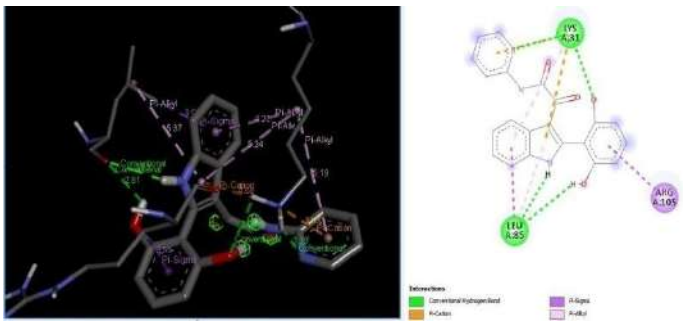

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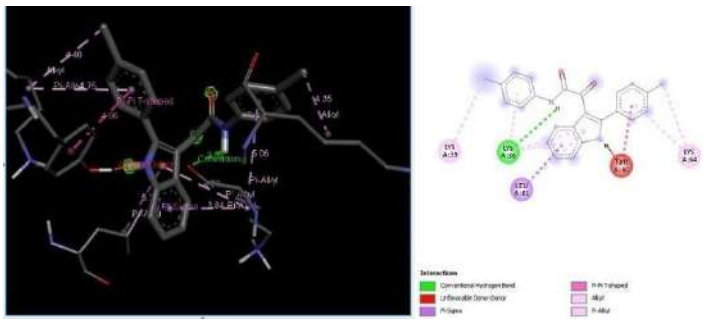

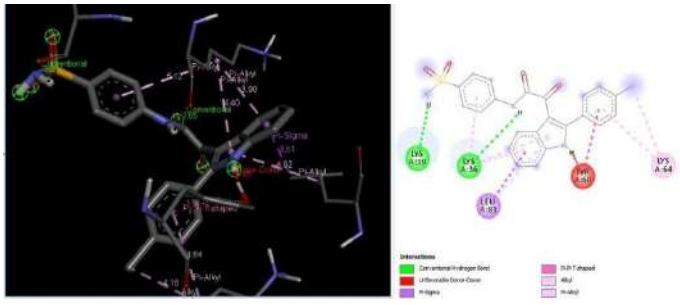

BINDING AFFINITY OFIG-55

Figure: 5 ***In silico*** **Docking Results of Lead Compounds against MDM2-P53 (by Autodock Vina)**

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RESEARCH ARTICLE

Length Biased Adya Distribution for Accelerated Failure Time Model in Survival Analysis and its Application

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ABSTRACT

In this paper, we introduced the Length Biased Adya (LBA) distribution as baseline distribution to develop a new Accelerated Failure Time (AFT) model named as Length Biased Adya Accelerated Failure Time (AFT) model which can be used for modeling of survival data. The present retrospective study was conducted on the basis of survival data. The statistical properties of this distribution including survival function, hazard function, moments, moment generating function and characteristic function has been derived. The maximum likelihood technique is used to estimate the parameters of the new distribution and new AFT model has been derived. Finally, the Length Biased Adya distribution for Accelerated failure time model has been demonstrated by using survival data.

Keywords: Length Biased Adya distribution, Accelerated Failure Time model, Moments, Maximum Likelihood Estimator and Survival Analysis.

INTRODUCTION

The Accelerated Failure Time (AFT) model was introduced by Cox (1972). It is an important regression model in survival analysis Khanal et al (2014).This model is sometimes applied in reliability analysis in industrial experiments. Numerous researches have been done by different authors on AFT model and it is used to analyze the failure time data to study the reliability of machines and can also be considered as a good alternative to Cox Proportional Hazard model to study the survival data Wei (1992).The Cox proportional hazard model is useful for the analysis of

survivorship data. Analyzing treatment effects based on the hazard function may sometimes reveal trends not obvious from analysis of survival curves Royston and Parmer (2002). If survival times follow a weibull distribution, the Cox Proportional hazard model can be re-parameterized as a weibull AFT model and AFT model deceleration factors should correspond to log-transformed hazard ratios Collett (2003). The proportional hazard model assumes that the effect of a covariate is to accelerate or decelerate the life period of a disease by some constant. In AFT model, most commonly used distributions are Weibull, Exponential, Gamma, Log normal, Log-logistic distribution and many more distributions. In this paper, we will introduce the Length Biased Adya distribution for AFT model having three parameters. The survival function of AFT model can be expressed as

$$S(t) = S_0(\alpha t) \quad \text{For } t \geq 0 \tag{1}$$

where, α denotes the joint effect of covariates,

$$\alpha = \exp\left(-\left(\omega_1 c_1 + \omega_2 c_2 + ... + \omega_n c_n\right)\right)$$

$$\alpha = \left(\exp(c'\omega)\right)$$

The factor $\left(\exp(c'\omega)\right)$ is known as the acceleration factor.

where*t* represents the survival time, c is a vector of covariates under study and ω is the vector of regression coefficients.

The AFT model is also known as the log location scale model given by Lawless (1982). Several AFT models already exist in literature such as the generalized gamma AFT model by Cox et al. (2007) and Olosunde et al. (2021) discussed log exponential power distribution and introduced a new AFT model namely log exponential power accelerated failure time model for modeling the survival times of patients suffering from chronic liver disease. Faruk (2018) studied proportional hazards and accelerated failure time models for analyzing the first birth interval data. Majeed (2020) proposed accelerated failure time model and its applications in insurance attrition.

Swindell (2009) presented accelerated failure time model to provide a useful statistical framework in terms of survivorship. Saikia and Barman (2017) revealed that gamma, weibull, log – logistic, log normal and exponential distributions have been widely used as AFT models and introduced Accelerated Failure Time models with its specific distributions in the analysis of esophagus cancer patients data. Ponnuraja and Venkatesan (2010) proposed and examined the AFT model which give better prediction than the Cox Proportional Hazard model. Othman (2021) discussed the AFT model to analyze lung cancer data and testing the validity of the estimated model in identifying the important factors that affect the patient survival time. In this paper, we developed the length biased Adya distribution which was derived from the transformation of Adya distribution shanker (2021). The new model is flexible and better fit to the other competing distributions. Finally, we applied the length biased Adya distribution for Accelerated failure time model in survival analysis of lung cancer data.

Length Biased Adya Distribution (LBA)

The probability density function (pdf) of Adya distribution is given by

$$f(x,\theta) = \frac{\theta^3}{\theta^4 + 2\theta^2 + 2}\left(\theta + x\right)^2 e^{-\theta x}\, x > 0, \theta > 0 \tag{2}$$

And its cumulative distribution function (cdf) is given by

$$F(x,\theta) = 1 - \left[1 + \frac{\theta_x\left(\theta x + 2\theta^2 + 2\right)}{\theta^4 + 2\theta^2 + 2}\right] e^{-\theta x} \tag{3}$$

Suppose X is a non-negative random variable with probability density function $f(x)$. Let $w(x)$ be the non-negative weight function, and then the probability density function of the weighted random variable X_w is given by

$$f_w(x) = \frac{w(x) f(x)}{E(w(x))} \quad x > 0 \tag{4}$$

Where $w(x)$ is a non-negative weight function and

$$E(w(x)) = \int w(x) f(x) dx \qquad 0 < E(w(x)) < \infty$$

For different weighted models, we can have different choices of the weight function $w(x)$. In this paper, we will introduce length biased version of Adya distribution, in weights we use $w(x) = x^c$ so we will take c=1 in weights x^c in order to get the length biased Adya distribution and its pdf is given as

$$f_l(x) = \frac{x f(x)}{E(x)}, x > 0 \tag{5}$$

where, $E(x) = \int_0^\infty x f(x;\theta) dx$

$$= \int_0^\infty x \frac{\theta^3}{\theta^4 + 2\theta^2 + 2} (\theta + x)^2 e^{-\theta x} dx$$

$$= \frac{\theta^3}{\theta^4 + 2\theta^2 + 2} \int_0^\infty x(\theta + x)^2 e^{-\theta x} dx$$

$$= \frac{\theta^3}{\theta^4 + 2\theta^2 + 2} \int_0^\infty x(\theta^2 + x^2 + 2\theta x) e^{-\theta x} dx$$

$$= \frac{\theta^3}{\theta^4 + 2\theta^2 + 2} \left[\theta^2 \int_0^\infty x e^{-\theta x} dx + \int_0^\infty x^3 e^{-\theta x} dx + 2\theta \int_0^\infty x^2 e^{-\theta x} dx \right]$$

$$= \frac{\theta^3}{\theta^4 + 2\theta^2 + 2} \left[\theta^2 \int_0^\infty x^{(2)-1} e^{-\theta x} dx + \int_0^\infty x^{(4)-1} e^{-\theta x} dx + 2\theta \int_0^\infty x^{(3)-1} e^{-\theta x} dx \right] \tag{6}$$

Using gamma function to above equation (5), we get

$$= \frac{\theta^3}{\theta^4 + 2\theta^2 + 2} \left[\theta^2 \frac{\Gamma 2}{\theta^2} + \frac{\Gamma 4}{\theta^4} + 2\theta \frac{\Gamma 3}{\theta^3} \right],$$

$$= \frac{\theta^3}{\theta^4 + 2\theta^2 + 2} \left[\frac{\theta^4 \Gamma 2 + \Gamma 4 + 2\theta^2 \Gamma 3}{\theta^4} \right]$$

$$= \frac{\theta^3}{\theta^4 (\theta^4 + 2\theta^2 + 2)} \left(\theta^4 \Gamma 2 + \Gamma 4 + 2\theta^2 \Gamma 3 \right)$$

$$E(x) = \frac{\theta^4 \Gamma 2 + \Gamma 4 + 2\theta^3 \Gamma 3}{\theta(\theta^4 + 2\theta^2 + 2)} \tag{7}$$

Substituting equation (1) and equation (6) in equation (4), we will obtain probability density function (pdf) of length biased Adya distribution as

$$f_l(x;\theta) = \frac{x\theta^4(\theta+x)^2 e^{-\theta x}}{\theta^4\Gamma 2 + \Gamma 4 + 2\theta^3\Gamma 3} \quad (8)$$

Now, we have to obtain cumulative distribution function (cdf) of length biased Adya Distribution

$$F_l(x) = \int_0^x f_l(x;\theta)dx$$

$$F_l(x;\theta) = \int_0^x \frac{x\theta^4(\theta+x)^2 e^{-\theta x}}{\theta^4\Gamma 2 + \Gamma 4 + 2\theta^3\Gamma 3} dx \int_0^x x(\theta+x)^2 e^{-\theta x} dx$$

$$= \frac{\theta^4}{\theta^4\Gamma 2 + \Gamma 4 + 2\theta^3\Gamma 3} \int_0^x \theta x(\theta+x)^2 e^{-\theta x} dx$$

$$= \frac{\theta^4}{\theta^4\Gamma 2 + \Gamma 4 + 2\theta^3\Gamma 3} \int_0^x x(\theta^2 + x^2 + 2\theta x) e^{-\theta x} dx$$

$$= \frac{\theta^4}{\theta^4\Gamma 2 + \Gamma 4 + 2\theta^3\Gamma 3} \theta^2 \int_0^x xe^{-\theta x} dx + \int_0^x x^3 e^{-\theta x} dx + \theta \int_0^x x^2 e^{-\theta x} dx$$

$$= \theta^2 \int_0^x xe^{-\theta x} dx$$

Put $\theta x = t \ \theta dx = dt$

$$x = \frac{t}{\theta} \ dx = \frac{1}{\theta} dt$$

$$= \frac{\theta^4}{\theta^4\Gamma 2 + \Gamma 4 + 2\theta^3\Gamma 3} \theta^2 \int_0^{\theta x} \frac{t}{\theta} e^{-t} \frac{dt}{\theta} + \int_0^{\theta x} \left(\frac{t}{\theta}\right)^3 \frac{1}{\theta} e^{-t} dt + 2\theta \int_0^{\theta x} \frac{t^2}{\theta^2} e^{-t} \frac{dt}{\theta}$$

$$= \frac{\theta^4}{\theta^4\Gamma 2 + \Gamma 4 + 2\theta^3\Gamma 3} \frac{\theta^2}{\theta^2} \int_0^{\theta x} te^{-t} dt + \frac{1}{\theta^4} \int_0^{\theta x} t^3 e^{-t} dt + \frac{2\theta}{\theta^3} \int_0^{\theta x} t^2 e^{-t} dt$$

$$= \frac{\theta^4}{\theta^4\Gamma 2 + \Gamma 4 + 2\theta^3\Gamma 3} \int_0^{\theta x} t^{2-1} e^{-t} dt + \frac{1}{\theta^4} \int_0^{\theta x} t^{4-1} e^{-t} dt + \frac{2}{\theta^2} \int_0^{\theta x} t^{3-1} e^{-t} dt$$

$$F_l(x) = = \frac{\theta^4}{\theta^4\Gamma 2 + \Gamma 4 + 2\theta^3\Gamma 3} \left[\gamma(2,\theta x) + \frac{1}{\theta^4} \gamma(4,\theta x) + \frac{2}{\theta} \gamma(3,\theta x) \right] \quad (9)$$

Then we will discuss about the survival function and hazard function of the length biased Adya distribution is given by

$$S(x) = 1 - F(x)$$

$$S(x) = \frac{\theta^4 + 4\theta^3 + 6 - \theta^4 \left(\gamma(2,\theta x) + \frac{1}{\theta^4} \gamma(4,\theta x) + \frac{2}{\theta} \gamma(3,\theta x) \right)}{\theta^4 + 4\theta^3 + 6} \quad (10)$$

The corresponding hazard function or failure rate is given by

$$h_l(x,\theta)=\frac{f_l(x,\theta)}{S_l(x,\theta)}$$

$$h(x)=\frac{x\theta^4(\theta+x)^2e^{-\theta x}}{\theta^4+4\theta^3+6-\theta^4\left(\gamma(2,\theta x)+\gamma(4,\theta)+2\theta^3\gamma(3,\theta)\right)} \tag{11}$$

Moments and Associated Measures

Let X_l denotes the random variable following length biased Adya distribution the r^{th} order moment, that is, $E(x^r)$

$$\mu_r'=E(x^r)=\int_0^\infty x^r f_l(x)dx$$

$$=\int_0^\infty x^r\frac{x\theta^4(\theta+x)^2e^{-\theta x}}{\theta^4+4\theta^3+6}dx$$

$$=\frac{\theta^4}{\theta^4+4\theta^3+6}\int_0^\infty x^{r+1}(\theta+x)^2e^{-\theta x}dx$$

$$=\frac{\theta^4}{\theta^4+4\theta^3+6}\int_0^\infty x^{r+1}(\theta^2+x^2+2\theta x)e^{-\theta x}dy$$

$$=\frac{\theta^4}{\theta^4+4\theta^3+6}\left[\theta^2\int_0^\infty x^{r+1}e^{-\theta x}dx+\int_0^\infty x^{r+3}e^{-\theta x}dx+2\theta\int_0^\infty x^{(r+2)-1}e^{-\theta x}dx\right]$$

$$=\frac{\theta^4}{\theta^4+4\theta^3+6}\left[\theta^2\int_0^\infty x^{(r+2)-1}e^{-\theta x}dx+\int_0^\infty x^{(r+4)-1}e^{-\theta x}dx+2\theta\int_0^\infty x^{(r+3)-1}e^{-\theta x}dx\right]$$

$$=\frac{\theta^4}{\theta^4+4\theta^3+6}\left[\frac{\theta^2\Gamma r+2}{\theta^{r+2}}+\frac{\Gamma r+4}{\theta^r+4}+\frac{2\theta\Gamma r+3}{\theta^{r+3}}\right] \tag{12}$$

Putting r=1 in equation (12), we will get the mean of length biased Adya distribution which is given by

$$\mu_1'=\frac{\theta^4}{\theta^3(\theta^4+4\theta^3+6)}\left[\theta^2\Gamma 3+\frac{\Gamma 5}{\theta^2}+\frac{2\theta\Gamma 4}{\theta}\right]$$

And putting r=2, we get the second moment of length biased Adya distribution as

$$\mu_2'=\frac{\theta^4}{\theta^4(\theta^4+4\theta^3+6)}\left[\theta^2\Gamma 4+\frac{\Gamma 6}{\theta^2}+\frac{2\theta\Gamma 5}{\theta}\right]$$

Variance $\mu_2=\mu_2'-(\mu_1')^2$

$$\mu_2=\left(\frac{\theta^4}{\theta^4(\theta^4+4\theta^3+6)}\left(\theta^2\Gamma 4+\frac{\Gamma 6}{\theta^2}+\frac{2\theta\Gamma 5}{\theta}\right)\right)-\left(\left(\frac{\theta^4}{\theta^4(\theta^4+4\theta^3+6)}\right)\left(\theta^2\Gamma 3+\frac{\Gamma 5}{\theta^2}+\frac{2\theta\Gamma 4}{\theta}\right)\right)^2$$

$$S.D(\sigma)=\sqrt{\frac{\theta_4}{\theta^4(\theta^4+4\theta^3+6)}\left[\theta^2\Gamma 3+\frac{\Gamma 5}{\theta^2}+\frac{2\theta\Gamma 4}{\theta}\right]}$$

Moment Generating Function and Characteristic function

Let **X** follows length biased Adya distribution and then the moment generating function (mgf) of X is given by

$$M_{X_l}(t) = E[e^{tx}]$$

$$= \int_0^\infty e^{tx} f_l(x)dx$$

Using Taylor's series expansion

$$M_X(t) = E(e^{tx}) = \int_0^\infty \left[1 + tx + \frac{(tx)^2}{2!} + \ldots\ldots\right] f_l(x)dx$$

$$= \int_0^\infty \sum_{j=0}^\infty \frac{t^j}{j!} x^j f_l(x)dx$$

$$= \sum_{j=0}^\infty \frac{t^j}{j!} \int_0^\infty x^j f_l(x)dx$$

$$= \sum_{j=0}^\infty \frac{t^j}{j!} \mu_j$$

$$M_X(t) = \sum_{j=0}^\infty \frac{t^j}{j!} \frac{\theta^4}{\theta^{j+2}\theta^4 + 4\theta^3 + 6}\left[\theta^2\Gamma j + 2 + \frac{\Gamma j + 4}{\theta^2} + \frac{2\theta\Gamma j + 3}{\theta}\right] \quad (13)$$

Similarly we can get the characteristic function of length biased Adya distribution.

$$\Phi_X(t) = M_X(it)$$

$$M_X(it) = \sum_{j=0}^\infty \frac{it^j}{j!} \frac{\theta^4}{\theta^{j+2}\theta^4 + 4\theta^3 + 6}\left[\theta^2\Gamma j + 2 + \frac{\Gamma j + 4}{\theta^2} + \frac{2\theta\Gamma j + 3}{\theta}\right] \quad (14)$$

Maximum likelihood Estimation

In this section, we will discuss the maximum likelihood of the parameters of Length Biased Adya distribution. Let $(x_1, x_2, \ldots\ldots x_n)$ be a random sample of size n from Length biased Adya distribution. Then likelihood function is given by

$$L(x,\theta) = \prod_{i=1}^n f(x;\theta)$$

$$= \prod_{i=1}^n \left[\frac{x\theta^4(\theta + x)^2 e^{-\theta x}}{\theta^4 + 4\theta^3 + 6}\right]$$

$$= \frac{\theta^4}{(\theta^4 + 4\theta^3 + 6)^n} \prod_{i=1}^n \left[x_i(\theta + x)^2 e^{-\theta x_i}\right] \quad (15)$$

The log likelihood function of equation (15) is

$$\log L = 4n\log - n\log(\theta^4 + 4\theta^3 + 6) + \sum_{i=1}^n \log x_i + 2\sum_{i=1}^n \log(\theta + x_i)^\theta - \theta\sum_{i=1}^n x_i \quad (16)$$

The maximum likelihood estimates of θ can be obtained by differentiating equation (16)with respect to θ and equate to zero

$$\frac{\partial \log L}{\partial \theta} = \frac{4n}{\theta} - n\left[\frac{4\theta^3\Gamma 2 + 6\theta^2\Gamma 3}{\theta^4 + 4\theta^3 + 6}\right] + 2\sum_{i=1}^{n}\left[\frac{1}{(\theta + x_i)}\right] - \sum_{i=1}^{n} x_i = 0 \qquad (17)$$

Because of the complicated form of likelihood equations (17) it is very difficult to solve the system of nonlinear equations. Therefore, we use R and Wolfram Mathematica for estimating the required parameter of the proposed distribution.

Length Biased Adya Distribution for Accelerated Failure Time Model (AFT)

In this section, we will estimate the parameters of the Length Biased Adya AFT model by using method of Maximum Likelihood Estimation. The Length Biased Adya density function (8) as well as its survival function (10) will be of great use. These two functions will be used as baseline distribution by substituting them in the likelihood function for estimating the parameters of AFT model. Then the likelihood function of the AFT model is given by

$$L = \prod_{i=1}^{n} f\left[(t_i)\right]^{\delta_i}\left[S(t_i)\right]^{1-\delta_i} \qquad (18)$$

where, $f(t_i)$ and $S(t_i)$ are the density function and survival function of the AFT model respectively, t_i represents the survival time and δ_i is a censoring indicator function,

where, $\delta_i = \begin{cases} 1 & if \ \ the \ \ event \ of \ \text{interest is occured} \\ 0 & if \ \ the \ \ event \ of \ \text{interest is not} \ \ occured \end{cases}$

The probability density function of Length Biased Adya Accelerated Failure Time model and is specified as

$$f(t) = \alpha \ f_0(\alpha t)$$

where $f_0(.)$ is the baseline survival function.

$$f(t) = \frac{\exp(c'\omega)\exp(\exp(c'\omega)t)\theta^4(\theta + \exp(c'\omega)t)^2 e(-\theta\exp(c'\omega)t)}{\theta^4 + 4\theta^3 + 6} \qquad (19)$$

The survival function of the Length Biased Adya Accelerated Failure Time model can be obtained by

$$S(t) = S_0(\alpha t)$$

where $S_0(.)$ is the baseline survival function.

$$S(t) = \frac{(\theta^4 + 4\theta^3 + 6) - (\theta^4\gamma(2, \theta\exp(c'\omega)t) + \gamma(4, \theta\exp(c'\omega)t) + 2\theta^3\gamma(3, \theta\exp(c'\omega)t))}{\theta^4 + 4\theta^3 + 6} \qquad (20)$$

The hazard function of the Length Biased Adya Accelerated Failure Time model is defined as

$$h(t) = \alpha \ h_0(\alpha t)$$

where $h_0(.)$ is the baseline survival function.

$$h(t) = \frac{\exp(c'\omega)\theta^4(\theta + \exp(c'\omega)t)^2 \exp - \theta(\exp(c'\omega)t)}{\theta^4 + 4\theta^3 + 6 - (\theta^4\gamma(2, \theta\exp(c'\omega)t) + \gamma(4, \theta\exp(c'\omega)t) + 2\theta^3\gamma(3, \theta\exp(c'\omega)t)} \qquad (21)$$

Estimating the parameters of Length Biased Adya AFT

Substituting equations (19) and (20) in equation (18), the likelihood function of length biased Adya AFT model is given by

$$L(t_i,\theta,\omega,c') = \prod_{i=1}^{n}\left(\frac{\exp(c'\omega)\exp(c'\omega)t_i)\theta^4(\theta+\exp(c'\omega)t_i))^2 e(-\theta(\exp(c'\omega)t_i)}{\theta^4+4\theta^3+6}\right)^{\delta_i} \times$$

$$\left(\frac{\theta^4+4\theta^3+6-(\theta^4\gamma(2,\theta\exp(c'\omega)t_i))+\gamma(4,\theta(\exp(c'\omega)t_i))+2\theta^3\gamma(3,\theta(\exp(c'\omega)t_i)))}{\theta^4+4\theta^3+6}\right)^{1-\delta_i}$$

The log likelihood function is given by

$$\log L = \log(\theta^4+4\theta^3+6)\sum_{i=1}^{n}\delta_i - 4\log\theta\sum_{i=1}^{n}(1-\delta_i)+\sum_{i=1}^{n}(1-\delta_i)\log\gamma(2,\theta\exp(c'\omega)t_i)$$

$$+\sum_{i=1}^{n}(1-\delta_i)\log\gamma(4,\theta\exp(c'\omega)t_i)+\log(2\theta^3)\sum_{i=1}^{n}(1-\delta_i)$$

$$-\sum_{i=1}^{n}(1-\delta_i)\log\gamma(3,\theta\exp(c'\omega)t_i) \qquad (22)$$

Differentiating equation (22), with respect to estimators θ,ω,c' then we have

$$\frac{\partial\log L}{\partial\theta} = \sum_{i=1}^{n}\delta_i\frac{4}{\theta}+2\sum_{i=1}^{n}\left(\frac{\delta_i}{\theta+\exp(c'\omega)t_i}\right)-\sum_{i=1}^{n}\delta_i\exp(c'\omega)t_i-\sum_{i=1}^{n}\delta_i\left(\frac{4\theta^3+12\theta^2}{\theta^4+4\theta^3+6}\right)$$

$$-\sum_{i=1}^{n}\frac{4(1-\delta_i)}{\theta^4}+\sum_{i=1}^{n}(1-\delta_i)\log(2,\theta\exp(c'\omega)t_i)+\sum_{i=1}^{n}(1-\delta_i)\log(4,\theta\exp(c'\omega)t_i)$$

$$+\sum_{i=1}^{n}\left(\frac{1-\delta_i}{2\theta^3}\right)-\sum_{i=1}^{n}(1-\delta_i)\log\gamma(3,\theta\exp(c'\omega)t_i) \qquad (23)$$

$$\frac{\partial\log L}{\partial\omega} = \sum_{i=1}^{n}(\delta_i c't_i)+\sum_{i=1}^{n}(\delta_i c')+\sum_{i=1}^{n}\frac{2\delta_i\exp(c'\omega t)c't_i}{(\theta+\exp(c'\omega)t_i)}-\theta\sum_{i=1}^{n}\delta_i(\exp(c'\omega t_i)c't_i)$$

$$+\sum_{i=1}^{n}(1-\delta_i)\log(2,\theta\exp(c'\omega)t_i)\sum_{i=1}^{n}(1-\delta_i)\log(4,\theta\exp(c'\omega)t_i)$$

$$+\sum_{i=1}^{n}(1-\delta_i)\log(3,\theta\exp(c'\omega)t_i) \qquad (24)$$

$$\frac{\partial\log L}{\partial c'} = \sum_{i=1}^{n}(\delta_i\omega t_i)+\sum_{i=1}^{n}\delta_i\omega+\sum_{i=1}^{n}\frac{2\delta_i\exp(c'\omega)t_i\,\omega t_i}{(\theta+\exp(c'\omega)t_i)}+\sum_{i=1}^{n}(1-\delta_i)\exp(c'\omega t_i)\,\omega t_i+\sum_{i=1}^{n}(1-\delta_i)$$

$$\log(2,\theta\exp(c'\omega)t_i)+\sum_{i=1}^{n}(1-\delta_i)\log(4,\theta\exp(c'\omega)t_i)+\sum_{i=1}^{n}(1-\delta_i)\log(3,\theta\exp(c'\omega)t_i)$$

$$-\sum_{i=1}^{n}(1-\delta_i)\log(3,\theta\exp(c'\omega)t_i) \tag{25}$$

Because of the complicated form of likelihood equations (23), (24) and (25) algebraically it is very difficult to solve the system of nonlinear equations. Therefore we use R and wolfram mathematics for estimating the required parameters.

Data Analysis

The data set consists of survival times (in month) of 64 patients suffering from lung cancer reported by Pena (2002). The data set are given below:

0.99, 1.28, 1.77, 1.97, 2.17, 2.63, 2.66, 2.76, 2.79, 2.86, 2.99, 3.06, 3.15, 3.45, 3.71, 3.75, 3.81, 4.11, 4.27, 4.34, 4.40, 4.63, 4.73, 4.93, 4.93, 5.03, 5.16, 5.17, 5.49, 5.68, 5.72, 5.85, 5.98, 8.15, 8.62, 8.48, 8.61, 9.46, 9.53, 10.05, 10.15, 10.94, 10.94, 11.24, 11.63, 12.26, 12.65, 12.78, 13.18, 13.47, 13.96, 14.88, 15.05, 15.31, 16.13, 16.46, 17.45, 17.61, 18.20, 18.37, 19.06, 20.70, 22.54, 23.36.

We consider the criteria like Bayesian Information Criteria (BIC), Akaike Information Criteria (AIC), Akaike Information Criteria Corrected (AICC) and -2 log L. The better distribution is one corresponding to lesser values of AIC, BIC, AICC and -2 log L. AIC, BIC, AICC and -2logL can be evaluated by using the formula as follows:

$$AIC = 2k - 2\log L \qquad BIC = k\log n - 2\log L \qquad AICC = AIC + \frac{2k(k+1)}{(n-k-1)}$$

Where, k is the number of parameters, n is the sample size and -2logL is the maximized value of log likelihood function, these values are shown in Table 1.

CONCLUSION

In this study, we introduced a new parametric model for the analysis of survival data called length biased Adya distribution has been proposed. The statistical properties of the proposed distribution have been derived and the parameters of the new distribution and new AFT model have been obtained by using maximum likelihood technique. The various information criteria suggested that proposed distribution provided better fit to the lung cancer data as compared over other distributions. Hence we observed the real life data better fit when only the survival times were modeled and compared with weibull, gamma and exponential distribution.

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Table 1: Comparison of Length Biased Adya distribution with some existing models when only the survival times of 64 patients from lung cancer data

Distribution	MLE	-2logL	AIC	BIC	AICC
Length Biased Adya AFT	$\hat{\theta} = 0.45431039$ (0.02704473)	395.6236	397.6236	399.7825	397.6881
Weibull AFT	$\hat{\theta} = 0.38491697$ (0.04570231) $\hat{\alpha} = 75.21054096$ (83.34711363)	400.944	404.944	409.2618	405.1407
Gamma AFT	$\hat{\alpha} = 0.53761651$ (0.03879194) $\hat{\theta} = 0.82641916$ (0.07863753)	489.084	493.084	497.4017	493.2807
Exponential AFT	$\hat{\theta} = 0.11481347$ (0.01435059)	405.0524	407.0524	409.2113	407.1169

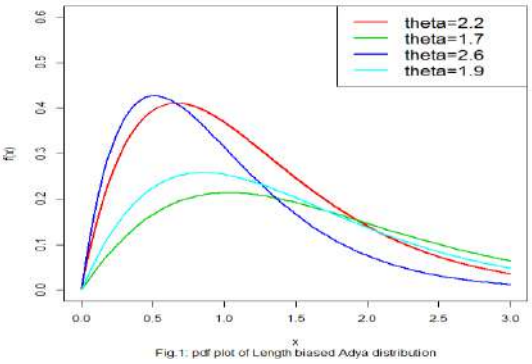

Fig.1: pdf plot of Length biased Adya distribution

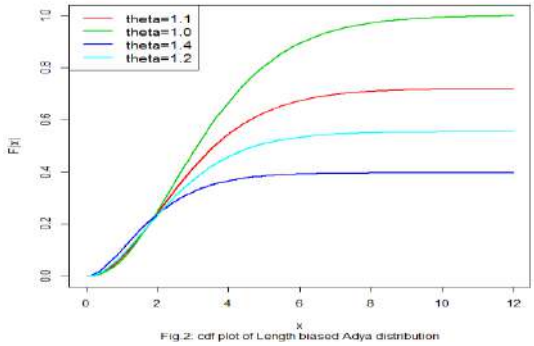

Fig.2: cdf plot of Length biased Adya distribution

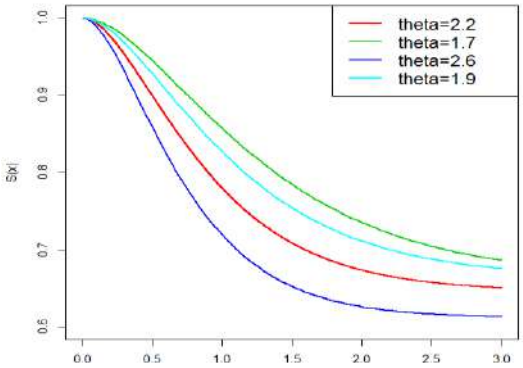

Fig.3: Survival plot of Length biased Adya distribution

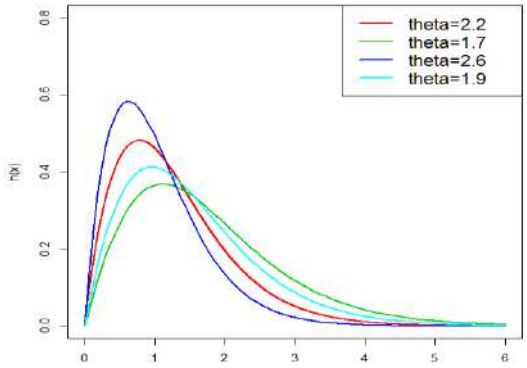

Fig.4: hazard plot of Length biased Adya distribution

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RESEARCH ARTICLE

Insight on Advanced Technologies and Natural Compounds against SARS-CoV-2

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ABSTRACT

Severe Acute Respiratory Syndrome Corona virus 2 (SARS-CoV-2), which causes corona virus disease (COVID-19) outbreak is now a global pandemic declared by WHO is a highly transmittable and pathogenic viral infection. Due to lockdown in numerous locations and the widespread fear of contagion, the majority of the population's life was severely interrupted leading to the evaluation of numerous antiviral drugs against SARS-CoV-2, which has resulted in clinical retrieval. Different fast and specific laboratory methods are used to detect viral infection. The current review article majorly emphasizes methods used in the detection of corona virus, drugs used for its treatment and role of medicinal plants against the protection of this viral pandemic. Besides, some Machine Learning and Artificial Intelligence-enabled techniques for early diagnosis in the current scenario have also been described.

Keywords: COVID-19; SARS-CoV-2; Natural products; Medicinal Plants; Phytochemicals; Artificial Intelligence

INTRODUCTION

In the past two years, due to the elevation of cases of anonymous pneumonia that occurred in Wuhan, China, World Health Organization (WHO) immediately declared public health emergency of international concern. Later, it was declared as the new 2019 corona virus outbreak, a global pandemic, leading to the arrival of the most lethal disease named corona virus disease 2019 (COVID-19) [1]. The name is derived due to its petal-shaped projections that give the virus an external crown (corona). The corona virus has a size ranging from 26 to 32kb, diameter 65-125 nm, lipid-enveloped, positive (+) single-stranded RNA genome, capped, and polyadenylated [2]. COVID-19 is referred to as the third-known highly transmittable zoonotic disease classified in family corona viridae and genus betacoronavirus, including Severe Acute Respiratory Syndrome (SARS) and Middle East respiratory syndrome (MERS) [3]. Genomic studies revealed the phylogenetic relationship of SARS CoV-2 with severe acute respiratory syndrome-like (SARS) bat viruses; viewing bat as the main possible reservoir [4]. Although there are no reports of an intermediate source of origin and transmission to human beings, however, confirmation of a human-to-human transfer has come into existence. The SARS-CoV-2 genome has been sequenced and revealed to be approx. 30,000 bases RNA molecule containing 15 genes, including the S gene that encodes a surface located protein of the viral envelope. Nature itself is an extensive source to provide various phytochemicals to develop various drugs for the treatment of different viral diseases [5]. India is well known for its diverse medicinal plants with excessive potential for antimicrobial and phytochemical activities. Natural materials and their derivatives are used in common medicine for the treatment of several diseases including viral infections [6].

Ayurveda and Siddha traditions are originated in India and are broadly used among the Indian populace. Indian medicinal herbs have already been proven as a potent drug for the treatment of various ailments [7,8]. Recently, certain natural products have been established to exhibit their antiviral activity by inhibiting viral replication [9]. In addition to compounds of plant origin [10], several compounds derived from the biotechnological approach [11] have been stated for their antiviral capabilities against diverse viruses. *Nigella sativa* is currently verified to illustrate inhibitory activity against the hepatitis C virus [12]. Identification of certain phytocompounds successfully characterizes medicinal plants, which facilitate to ease the infection. Therefore, Indian medicinal plants should be promoted more for innovative treatment options that might define their role in fighting this viral communication. To date, numerous herbal medications or their components have shown possible activity against the certain virus [13]. However, suitable investigation of anti-CoV agents from these natural products is deficient. These agents are not only significant in making CoV hostile but also play a substantial role to avoid viral attacks. In addition to this, numerous computer-based approaches along with machine learning algorithms are also being employed by researchers to estimate virus propagation and to foresee the future [14]. The artificial intelligence (AI) and machine learning (ML) approach is used for automatic diagnostic systems, besides, protecting healthcare workers [15]. This article draws a kind concern that the use of phytochemicals extracted from medicinal herbs to combat viral spread. In this article, various techniques used in the detection of COVID-19 infection along with, an overview of different ML-models and AI-enabled apps to anticipate COVID-19 pandemic breakout has been emphasized. Simultaneously, the potential use of certain natural compounds derived from Indian medicinal herbs to act against viral disease is also discussed.

Emerging analytical technologies for testing Coronavirus

The novel coronavirus was also identified as SARS-CoV-2 and recognized as a sister virus to SARS-CoVs by the Coronavirus Study Group (CSG) of the International Committee on Taxonomy of Viruses. The rate of spread of this virus is increasing every single day; however, various advanced techniques have been acquainted for diagnosing, treating, and preventing COVID-19. Methods for detecting SARS-CoV-2 come under three categories. The first category contains molecular approaches using Polymerase Chain Reaction (PCR) based techniques like Reverse Transcription PCR (RT-PCR) and Isothermal Amplification, the second category emphasizes immunological and serological assays [16] and third category based on machine learning and artificial intelligence-based approaches.

Molecular approaches for testing COVID-19

Reverse Transcription-Polymerase Chain Reaction (RT-PCR)

RT-PCR relies on the conversion, amplification, and identification of genetic material of the virus, in particular. In this technique respiratory sample of an infected person is being used. Mainly, the use of serum, stool, or ocular secretion has been reported while detecting COVID-19 [17]. Besides, a combo kit of TaqPath COVID-19 has recently been made by Rutgers Clinical Genomics Laboratory that uses self-collected saliva samples for diagnosis. The genetic material of SARS-CoV-2 is RNA, and PCR amplifies a well-defined segment of DNA. Therefore, initially, RNA of the SARS-CoV-2 virus transformed to DNA by using reverse transcription, and then the resulting DNA gets amplified by PCR and examined to determine similarity with the exact genetic code of SARS-CoV-2. RT PCR kits available to date contain three assays, each one targeting a specific gene in the viral genome. The target sites are ORF1b or ORF8 regions (Open Reading Frame), the N-gene (the nucleocapsid protein), the E-gene (envelope protein), S protein. Currently, various COVID-19 diagnostic tests are available which include, COVID-19 RT-PCR, 2019-Novel Coronavirus Real-Time RT-PCR Diagnostic Panel, Allplex 2019-nCoV Assay, TaqPath COVID-19 Combo kit, and Cobas SARS-CoV-2 [16].

Isothermal Amplification

The isothermal amplification technique is similar but much faster as compared to PCR, because of no involvement of repeated cycles of heating and cooling. It is an alternative strategy for amplification of the genome at a constant temperature. The latest method, Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) comes under this assay. The gene-editing CRISPR-based assay is currently being used for the detection of SARS-CoV-2. The enzymes of Cas12 and Cas13 families are being used in DETECTR assay and SHERLOCK method respectively, to target and edit SARS-CoV-2 gene sequence [18, 19]. This technique of isothermal amplification is cost-effective, does not consume time, does not require complex instrumentation, and has good potential for timely diagnosis.

Immunological and Serological Approaches

These testing methods rely upon the existence of Immunoglobulin M (IgM) and Immunoglobulin G (IgG) antibodies in the biological fluids such as blood plasma, sputum, serum, etc., of an infected person. These antibodies are the indicators of early-stage infection (IgM) and prior infection (IgG). Recently, the immunological assay has been increased to detect antibodies along with pathogen-derived antigens. Serological and immunological testing such as ELISA (enzyme-linked immunosorbent assay), the technique used to detect and quantify proteins, antibodies, peptides, etc. Luminescent Immunoassay (a peptide-based chemiluminescence enzyme immunoassay is used to determine COVID-19) [20], Biosensor Test (conversion of a biomolecule into measurable form via optical or electrical methods), and Antigen Test (use of monoclonal antibodies for capturing viral antigens) have good potential for the epidemiology of COVID-19.

ML and AI-based Approaches for diagnosing COVID-19

Artificial intelligence (AI) is a large subject of computer science devoted to the development of intelligent computers capable of doing tasks that would typically need human intelligence. A machine learning model is a strategy for predicting output for a given input that is modelled by the training process. It learns from previous experiences without being explicitly programmed. It's a mathematical representation that's utilized to map inputs to outputs for a specific dataset to create a machine learning model. The target attribute is required to run the machine learning algorithm. A Linear Regression model, which is a simple supervised learning model, depicts the relationship between features (independent variables) and labels (dependent variables) and provides a correlation between them [21]. The model can make predictions about the data after it has been trained. The forecast of a pandemic is a complex situation with multiple independent variables. Machine learning, Natural Language Processing, and Computer Vision can be used to anticipate COVID-19 infections and aid in the development of effective control and prevention techniques [22]. COVID-19 outbreaks can be detected with artificial intelligence systems that use machine learning algorithms, and the propagation of viruses can be predicted around the world [23]. Simple machine learning models like traditional Time Series Forecasting to complex machine learning models like Neural Network which takes high input data (multi-variate) can be applied for forecasting [24].

ML and AI-Enabled Apps: Recent Research

COVID-19 Sounds App is supported by the University of Cambridge and partly funded by European Research Council. Its main goal is to gather voice, breathing, and coughing sounds from healthy and unhealthy volunteers on a wide scale for a few seconds. This app also collects some basic information via questionnaires, which will aid in the development of a machine learning predictive model for early COVID-19 diagnosis [25]. Refer website link for more information https://www.covid-19-sounds.org/en/. COVID Symptom Study is a smartphone app (https://covid.joinzoe.com/) which is previously known COVID Symptom Tracker, was developed by Zoe Global with collaborating institutions: Kings College London and Massachusetts General Hospital. By using algorithms, this app can predict who has the virus and track infections based on self-reported information about COVID-19. This study also looks into multivariate logistic regression for adjusting age, gender, and BMI. Combination of loss of smell, taste, fatigue, cough, and loss of appetite results in the best prediction model for COVID-19 [26]. COVID Scholar (https://covidscholar.org/), a COVID-19 search engine incorporating machine learning that selects a related keyword and suggests research to the researcher. This website employs natural language processing (NLP) to search a collection of COVID-19-related academic publications and overcomes the traditional method of searching through literature [27]. It reduces the number of time researchers and scientists spend looking for virus-related solutions and finding effective solutions.

Drugs

The number of confirmed positive cases of COVID-19 is reported to WHO, which continues to increase worldwide and yet there is no specific anti-viral treatment. Vaccine development received immediate funding, but the development and evaluation of specific drugs to treat COVID-19 will take time. Meanwhile, a variety of existing host-directed therapies that are safe could potentially be reused to treat COVID-19 infection [28, 29]. Initially, according to China's Ministry of Science and Technology, Hisun Pharmaceutical's Favilavir is one of the best drugs that have shown results to prevent the COVID-19 from spreading and to further harm the health of the world's population in initial trials. Flavilavir worked as an effective antiviral medication to fight RNA infections by inhibiting the RNA-dependent RNA polymerase. Also, this drug is considered an effective treatment for influenza in Japan and China [30]. It was in February when regulatory officials in China first announced their approval of the antiviral "Favilar" for use as a treatment for COVID-19 [28]. Another recent study showed the effectiveness of hydroxychloroquine in eliminating the nasopharyngeal transport of SARS-CoV-2 in COVID-positive patients [30]. A considerable difference was observed between patients treated with hydroxychloroquine and controls (untreated) who started on day 3 after enrolment. Chinese researchers have published the results on the demonstration of chloroquine and hydroxychloroquine activity that slows down SARS-CoV-2 in *in vitro* conditions andthey found that hydroxychloroquine has a half-maximal effective concentration (EC50) of 0.72%μM which is more powerful than chloroquine having an effective concentration (EC50) of 5.47%μM [31]. Venkatraman and his research team recently proposed radiation therapy against this disease. They expected that it may play an important role to increase the overall survival of the patients and controlling the disease by delivering a minimum dose (in terms of Gray) of radiation to the patient, to de-activate COVID-19 infected cells [32]. As we are aware that, pandemic disease COVID-19 has occurred in 3 phases till now. Due to the mutating tendency of this virus it shows diverse symptoms. Therefore, a variety of medicines were used in every phase. Apart from hydroxychloroquine used in first wave, doctors prescribed medicines including ivermectin, doxycycline, azithromycin, vitamin C, vitamin D and zinc along with some steroids for critically ill patients in second phase of disease. These medicines were found to be very effective and most of the patients were cured at their homes [33]. Simultaneously, some European and Asian countries were emphasized to produce various effective COVID-19 vaccines to train the immune system of human using a harmless form of the virus. Therefore, five types of vaccines came into existence including adenovirus vaccines (The Oxford/AstraZeneca, the J&J, CanSino, & Sputnik V (Gamaleya) vaccines), mRNA vaccines (The Moderna & Pfizer/BioNTech COVID-19 vaccines, as well as the CureVac & Inova pharmaceuticals.), inactivated vaccines (Sinovac, Sinopharm, & the Bharat Biotech vaccines), attenuated vaccine (The Codagenix vaccine, but It's currently only in trials) and protein vaccine (The Novavax vaccine, & Sanifi/GSK vaccine). In addition, people were also advised to focus upon medicinal plants along with practicing yoga to boost their immune system against viral attack.

Medicinal plants with inhibitory properties against viral infections

The potential use of medicinal plants has been observed globally. However, their extensive applications have been confined to Asian countries like India, China, Japan, Pakistan, Sri Lanka, Thailand, and several African countries. Now, industrialized countries are also encouraging the use of plant-based natural medicinal products in their healthcare system. Molecular mechanisms related to the antiviral effects of plant extracts may differ among diverse groups of viruses. Though, the potential of plant extracts to enhance the inherent antiviral defence in human body involve a complex immune system that might employ common pathways. Recently, several studies explored the immune-stimulatory features of plant extracts possessing antiviral properties [34], perhaps, herbal plants showing broad antiviral effects might be advantageous against such infection. In India, the Himalayan region and the mountain ecosystem have been evolved as a potent source of numerous medicinal plants. Several studies on medicinal plants showed their therapeutic effect against various bacterial, fungal, and viral diseases. Natural bioactive compounds such as flavonoids, phenols, terpenes, quinines, etc., have been reported from these plants to possess antibacterial, antifungal, and antiviral potential [32]. Dhawan in 2012, highlighted the potential of numerous Indian medicinal plants exhibiting compounds such as curcumin, andrographolide, glycyrrhizic acid, and extracts of *Azadirachta indica* as well, that shows antiviral activity [35]. Due to the augmentation of COVID-19 pandemic situation in the world, various scientists and researchers are working on every aspect to build a suitable drug or vaccine for ending this disease. Perhaps, exploration of various high-value medicinal plants could be helpful in any possible way. In addition to this, WHO is also emphasizing the investigation of traditional medicinal plants against coronavirus. According to WHO-Africa (2020), *Artemisia annua* can be considered as a possible treatment for COVID-19 [36]. Efferth and his research team reported two compounds named artemisinin and artesunate isolated from *Artemisia annua* to inhibit hepatitis B virus, hepatitis C virus, human cytomegalovirus, and bovine viral diarrhea virus [37]. Indian medicinal plants including *Hottuynia cordata, Glycyrrhiza glabra, Alpinia officinarium, Nigelia sativa*, etc., showed activity against given respiratory viruses such as SARS, H1N1, Influenza, Newcastle [38].

A diverse herbal (medicinal) plants have the potential to inhibit serious infections caused by viruses in humans such as measles viruses [39, 40], human rotaviruses (HRV) [40, 41]respiratory syncytial virus (RSV), human rhinoviruses [42], coxsackie group of viruses [43, 44], neurotropic Sindbis virus (NSV) [45]and various strains of poliovirus [46-48]. Any herbal extract's antiviral action must be molecularly dichotomized before it can be evaluated. For example, a molecular analysis of hot water extracts of *Stevia rebaudiana* L. blocked the entry of several infectious serotypes of HRV into the permissive cells through anionic polysaccharide having a molecular weight of 9800 with uronic acid as a major sugar component [40]. Similarly, an alkaloid extract of *Haemanthus albiflos* bulbs inhibited RNA synthesis of HRV propagated in MA-104 cells [40].Various other medicinal plants exhibiting their activity against certain viruses are shown in Table 1. The aforementioned information justifies the antiviral or antimicrobial property of medicinal plants, likely to, possess anti-infectious compounds. Therefore, it is enough to further explain the concept, phytochemical activities of medicinal plants against COVID-19 positive patients may tend to give positive outcomes. Additionally, screening procedures aiming at identifying possible anti-infectious compounds from medicinal plants have a lot of promise in the pharmaceutical industry [49]. According to the Ministry of Ayush an ayurvedic company named Patanjali Ayurved in India has introduced an ayurvedic medicine named Divya Swasari Coronil Kit as an immunity booster. These ayurvedic tablets are constituted in joint research by Patanjali Research Institute and National Institute of Medical Science (NIMS), Jaipur. Coronil consists of extracts of various herbal medicinal plants such as *Tinospora cordifolia, Withania somnifera, Ocimum sanctum, Acacia arabica, Glycyrrhiza glabra, Pistacia integerrima, Zingiber officinale, Piper longum* as major ingredients. These medicinal plants showed a positive effect on corona virus-affected patients.

In silico screening of natural compounds

Recently, Joshi and his colleagues carried out an experiment using a virtual screening of phytochemicals to uncover novel antiviral agents [50]. They developed a phytochemical library comprising 318 phytochemicals from 11 plants with antiviral, antibacterial, and antifungal activities. The phytochemical library was subjected to virtual screening against molecular targets; Main protease (Mpro) and ACE2. It has been suggested that these compounds can be tested against Coronavirus and used to develop effective antiviral drugs. In a current study, *in silico* efficacy of some

natural compounds was compared against COVID-19 Mpro and ACE2 protein to that of Hydroxy-Chloroquine.The analysis revealed that Quercetin, Cirsimaritin, Hispidulin, Artemisin Curcumin, and Sulfasalazine showed better potential inhibition than Hydroxy-Chloroquine and has better binding affinity against Mpro of COVID-19 protease active site and ACE2 receptor [51]. A similar kind of study was also done by Naik and his team in which *in silico* techniques such as receptor-ligand docking, Molecular dynamic (MD), and ADMET (Absorption, Distribution, Metabolism, Excretion, and Toxicity) properties were used to select natural compounds. They searched for effective inhibitors against 6 potent SARS-CoV-2 therapeutic targets throughout virtual screenings based on the Natural Product Activity and Species Source (NPASS) database. Amongst 35,032 selected compounds, 21 compounds showed maximum docking scores relative to their respective known inhibitors and proposed that these compounds could be excellent candidates for the development of therapeutic drugs against SARS-CoV-2 [52]. The consumption of numerous species such as turmeric (*Curcuma longa*), ginger (*Zingiber officinale*), cinnamon (*Cinnamomum verum*), garlic (*Allium sativum*), coriander (*Coriandrum sativum*), black pepper (*Piper nigrum*), clove (*Syzygium aromaticum*), and medicinal plants such as giloy (*Tinospora cordifolia*), neem (*Azadirachta indica*), alovera (*Aloe barbadensis*), mint (*Mentha*) along with yoga and Ayurveda on daily routine has favored the immunity of Indian people and similar measures were also given by Ministry of AYUSH. In contrary to this, people with an age group above 60 and those underlying medical problems like cardiovascular disease, diabetes, chronic respiratory disease, and cancer are found to be more prone to COVID-19 infection. Optimistically, WHO (2020) stated that Indians have a tremendous capacity to deal with the pandemic as it has earlier experience of eradicated polio and smallpox.

CONCLUSION

SARS-CoV-2 is a lethal infectious pathogen and a global threat. Ongoing molecular diagnostic approach and worldwide test kit delivery promote faster and more accurate diagnostic solutions. Several advanced diagnostic techniques have been evolved to test COVID-19 all over the research labs, which are also discussed in the current review. According to epidemiologists, ML models can help anticipate the spread of a virus and make numerous decisions, such as determining who has the disease and predicting who is likely to get it. Epidemiological, clinical, and genetic data are gathered for management and pre-processing before being fed into a deep learning technique for autonomous patient detection and monitoring. It aids in the speeding up of the medication development process. Machine learning models and AI tools are also beneficial to healthcare practitioners that work in high-stress environments. As a result, the current review focuses on the use of forecasting models in the decision-making process for individuals, governments, and healthcare personnel to enable them to take appropriate action to combat the virus's spread and to serve as a model for future epidemics and pandemics. Apart from this, the crude extract of effective phytoextracts and a combination of different extracts could be those that exert extreme effects against COVID-19 virus due to its natural origin, safety, limited side effects, and its low cost against synthetic drugs. Plants synthesize and preserve a variety of natural compounds and biochemical products possessing potential therapeutic index, abetting elimination, or inhibition of viruses. Some important medicinal plants discussed in the current review could be exploited at least to strengthen the immunity of the universal population in certain epidemics. Additionally, plants that showed strong antiviral activity can subsequently be investigated for their ability to inhibit the life cycle of a virus. The results of such studies can be used as an alternative therapeutic compound in the treatment of SARS-CoV-2 infected patients or animals in the future. In India, particularly the high-altitude regions of Uttarakhand possess a diverse group of medicinal plants used against viral infection, however, only a few studies related to them *in vitro* validation has been acknowledged.

Conflict of Interest

All authors declare no conflict of interest.

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Table: 1 Medicinal plants and their activity against certain viruses

S. No.	Plants	Plant Parts	Compounds	Test Microorganisms	References
1	*Lycoris radiata*	Stem cortex	Lycorine	SARS-CoV	[53]
2	*Artemisia annua*	Whole plant	CNI	SARS-CoV	
3	*Pyrrosia lingua*	Leaves	CNI	SARS-CoV	
4	*Lindera aggregate*	Root	CNI	SARS-CoV	
5	*Hyoscyamus niger*	Flower	Amantadine HC	Influenza A	
6	*Gentiana scabra*	Rhizome	CNI	SARS-CoV	
7	*Dioscorea batatas*	Tuber	CNI	SARS-CoV	
8	*Cassia tora*	Seeds	CNI	SARS-CoV	
9	*Taxillus chinensis*	Dried stem	CNI	SARS-CoV	
10	*Cibotium barometz*	Rhizome	CNI	SARS-CoV	
11	*Morus* spp (*Morus alba var. alba, Morus alba var. rosa, and Morus rubra*)	Leaves and stem	Alkaloids (1-deoxynojirimxycin), Prenylated flavonoids (kuwanon G), and Stilbenoids (mulberroside A)	HCoV 229E and members of Picornaviridae family	[54]
12	*Iresine herbstii*	Shoot	CNI	Avian Newcastle Disease virus	[55]
13	*Justicia adhatoda*	Leaves	Vasicine alkaloids	Influenza	[56]
14	*Zingiber officinale Roscoe*	Rhizome	4, 6-Dichloroflavan (flavanoid)	Rhinovirus IB	
15	*Ocimum basilicum*	Whole plant	Ursolic acid (triterpenoid), Apigenin (Flavonoid), linalool (monoterpenoid)	Adenovirus (ADV-8)	
16	*Plantago major*	Whole plant	Aucubin (iridoid glycoside), Benzoic compounds (caffeic acid, chlorogenic acid)	Human adenovirus (ADV-3, ADV-8, ADV-11)	
17	*Verbascum thapsus*	Aerial parts	Phenylethanoid and lignin glycosides	Influenza A virus	

CNI= Compound Not Identified

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RESEARCH ARTICLE

Qualitative Phytochemical Difference Analysis of Medicinal Plants: *Taraxacum officinale*, *Geranium wallichianum* and *Elaeagnus parvifolia*

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ABSTRACT

Phytochemical screening is an important step in detecting bioactive principles contained in a medicinal plant, and it might lead to the development of new drugs. The existence of major phyto constituents in three traditional medicinal plants was investigated to link their presence to the plants' bioactivities. Standard techniques were used to screen the plants, which revealed the presence of tannins, flavonoids, phenolics, saponins, steroids, cardiac glycosides, and alkaloids. Further research on these plants is needed to assess their pharmacological potentials, isolate, describe, and clarify the structures of the bioactive chemicals that are responsible for their actions and other medicinal benefits

Keywords: Phytochemicals; Medicinal Plants; *Taraxacum Officinale; Geranium wallichianum; Elaeagnus parvifolia;*

INTRODUCTION

Individuals and communities benefit greatly from medicinal plants. Plants have therapeutic value because they contain chemical compounds that have a specific physiological effect on the human body. Natural goods, especially those derived from plants, including species, have been studied for their properties and health benefits. Plants have

laid the foundation for sophisticated traditional medical techniques that have been practiced for thousands of years by people around the world[1].Furthermore, the use of herbal therapy to cure illnesses and infections dates back to the dawn of time. Traditional medicine is supported by the World Health Organization if it has been proved to be effective and safe [2]. Plant compounds are classified as secondary metabolites since the plants that produce them may not require them. They are produced in all sections of the plant body, including bark, leaves, stem, root, flower, fruits, seeds, and so on.In other words, active components may be found in any part of the plant body [3]. These molecules act in tandem with nutrients and fiber to build a comprehensive defense mechanism against a variety of illnesses and stressors [4]. Secondary metabolites are the chemical compounds in question. Alkaloids, terpenoids, tannins, saponins, and phenolic chemicals are the most significant bioactive plant families [5]. The relationship between phytoconstituents and plant bioactivity is important to understand for the synthesis of compounds with particular activities that may be used to treat a variety of health problems and chronic diseases [6]. The presence of various phytochemicals in crude plant extracts has been linked to the negative effects of leachates, root exudates, or decomposing plant residues on other vegetation or subsequent crops [7]. Medicinal plants typically include a variety of chemical components that work together to improve health, either separately, additively, or synergistically [8]. Bitter chemicals are believed to stimulate digestion, whereas phenolic components are responsible for plant extracts' anti-inflammatory and antioxidative properties. As a result, in recent decades, attention has shifted to the elucidation of these pharmacologically significant chemicals in plants. Due to the importance of such early phytochemical screening of plants in the aforementioned context, there is an urgent needto identify and develop new therapeutic molecules with increased efficacy. Phytochemical studies of various medicinal plant species, as well as the therapeutic effects of crude chemical compounds on crops and plants, have produced promising results [9]. The quality phytochemistry of three medicinal plants utilized by the people of Kashmir, Pakistan, was discovered in this study.

MATERIALS AND METHODS

Plant collection and Identification

Plant samples were gathered from the districts of Kallakurichi, Tamil Nadu. Each plant species was authenticated by Plant botanist Professor. P. Jayaraman, Plant anatomical Research Centre, West Tambaram. Tamil Nadu and specimen No. deposited for further reference. After that, each plant sample was air-dried and ground into a coarse powder. The coarse powder was sifted through sieve no. # 60 and stored in anairtight container for further studies.

Preparation of plant extracts

The plant components were dried in the shade until all of the water molecules had evaporated and the plants were dry enough to grind. Following drying, the plant components were crushed into a fine powder using a mechanical blender and stored in airtight containers with adequate labeling for future use.

Hot water extraction

In a beaker, 5gm of finely powdered dried plant material was mixed with 200ml of distilled water. For 20 minutes, the mixture was cooked on a hot plate with constant stirring at 30°-40°C. The water extract was then filtered using filter paper before being utilized for phytochemical analysis. When not in use, the water extract was stored in the refrigerator. Extraction of solvents The Soxhlet extraction method was used to make crude plant extract. About 20g of powdered plant material was packed evenly into a thimble and extracted with 250ml of 70% hydro alcoholic solvent. The extraction procedure continues for 24 hours or until the solvent in the extractor's syphon tube becomes colorless. The extract was then placed in a beaker and cooked on a hot plate at 30-40oC until all of the solvent had evaporated. The dried extract was stored at 4°C in the refrigerator for later use in phytochemical analysis.

Phytochemical Screening

The following procedures were used to perform a preliminary qualitative phytochemical screening [10].

Test for Alkaloids
Individual extracts were diluted with dilute Hydrochloric acid and filtered.

Mayer's Test
The filtrates were treated with Mayer's reagent (Potassium Mercuric Iodide). The development of a yellow-colored precipitate indicates the presence of alkaloids.

Wagner's Test
1 mL extract and 1 mL Wagner's reagent (dilute iodine solution) are combined. The presence of alkaloids is indicated by the formation of reddish-brown precipitates.

Dragendroff's Test
The filtrates were treated with Dragendroff's reagent (solution of Potassium Bismuth Iodide). The development of red precipitate indicates the presence of alkaloids.

Hager's Test
The filtrates were treated with Hager's reagent (Saturated picric acid solution). The presence of alkaloids was revealed by the development of a yellow-colored precipitate.

Detection of Carbohydrates
Each extract was filtered individually after being dissolved in 5 mL of distilled water. Analysis of the filtrates revealed the presence of carbohydrates.

Molisch's Test
In a test tube, 2 drops of alcoholic -naphthol solution were added to the filtrates. The purple ring produced at the junction indicates the presence of carbohydrates.

Benedict's Test
The filtrates were prepared using Benedict's reagent, which was then gently heated. An orange-red precipitate indicates the presence of reducing carbohydrates.

Fehling's Test
The filtrate is hydrolyzed in Fehling's A and B solutions, neutralized with alkali, and boiled in dilute HCL. The development of red precipitate indicates the presence of reducing carbohydrates.

Detection of Flavonoids
Alkaline Reagent Test
The extracts are treated with a few drops of sodium hydroxide solution. When weak acid is introduced, a bright yellow color appears, which fades to colorless when flavonoids are present.

Lead acetate Test
To the extracts, a few drops of lead acetate solution were added. The development of a yellow-colored precipitate indicates the presence of flavonoids.

Shinoda Test
Add 8-10 drops of concentrated HCl and a sprinkle of magnesium powder or filing to 1ml of the extract. Cook for 10 to 15 minutes before removing from the heat. The presence of flavonoids is indicated by a red coloration.

Detection of Phytosterols

Salkowski's Test

The extracts were cleaned with chloroform until purified after being treated with a few drops of Conc. Sulphuric acid, the filtrates were shaken and left to stand. The development of a golden yellow color indicates the presence of triterpenes.

Libermann Burchard's Test

Along the edges of the tube, add 2ml of acetic anhydride and 2ml of H2SO4 concentrate to 0.5 ml of the extract. The presence of steroids is indicated by the development of green color.

Detection of Glycosides

Before checking the glycosides, the extracts were hydrolyzed with dilute HCL.

Modified Borntrager's Test

After washing with ferric chloride solution, the extracts were soaked in hot water for 5 minutes. The mixture was chilled before being separated in equal portions with benzene. The benzene film was removed and cleaned with an ammonia solution. The development of rose-pink color in the ammoniacal layer indicates the presence of ethanol glycosides.

Legal's Test

The extracts are treated with sodium nitroprusside in pyridine and sodium hydroxide. The development of a pink to blood-red tint indicates the presence of cardiac glycosides.

Keller-KillaniTest

2ml of glacial acetic acid containing one drop of ferric chloride solution and 1ml concentrated sulphuric acid are added to 5ml of extract. The presence of cardiac glycosides is indicated by a brown ring at the interface.

Detection of Phenols

Ferric Chloride Test

The extracts are given 3-4 drops of ferric chloride solution. The development of a blue-black color indicates the presence of phenols.

Liebermann's Test

1 mL sodium nitrite, a few drops diluted sulphuric acid, and 2 mL diluted NaOH to 1 mL extract. The presence of phenol is indicated by the presence of a strong red, green, or blue color.

Detection of Tannins

Gelatin Test

The extract was treated with a 1% gelatin solution containing sodium chloride. The development of white precipitate indicates the presence of tannins.

Modified Prussian Blue Test

To 1ml of the extract, add 1ml of 0.008M potassium ferricyanide and 1ml of 0.02M $FeCl_3$ in 0.1 M HCl. The appearance of blue color indicates the presence of tannins.

Detection of Saponins

Froth Test

In a water bath, 2g of powdered sample is cooked with 20ml of distilled water and filtered. 10 mL filtrate is combined with 5 mL distilled water and shaken vigorously to obtain a stable, persistent froth. The frothy is

combined with three drops of olive oil and shaken vigorously. It is possible to see the emulsion forming for the affirmative outcome.

Foam Test

2 ml of water and 0.5-gram of extract were combined in a shaker. If the foam produced lasts more than 10 minutes, saponins are present.

Detection of Proteins and Amino Acids

Xanthoproteic Test

The extracts receive a few drops of strong nitric acid. The development of yellow color indicates the presence of proteins. Ninhydrin Test (B): The extract was heated for a few minutes after adding 0.25 percent w/v ninhydrin reagent. The development of a blue color indicates the presence of amino acids.

Detection of Diterpenes

Copper acetate Test

After dissolving the extracts in water, 3-4 drops of copper acetate solution were added. The development of emerald green color indicates the presence of diterpenes [11].

Detection of Terpenoids

Salkowski Test

Add 2 ml of chloroform and 3 ml of concentrated H2SO4 to 5 mL extract. The presence of terpenoids was demonstrated by forming a yellow color ring at the interface of the two liquids which became reddish-brown after two minutes.

Detection of Starch

A 50 percent Iodine solution was added to identify the presence of starch. It was discovered that there was a blue-black speck.

Statistical analysis

Variations between the species in respect of Phytochemicals were calculated by one-way ANOVA using Student "t" test as statistical tool.

RESULTS AND DISCUSSION

To determine the existence of bioactive components, a preliminary qualitative phytochemical screening of the crude powder of three plants was performed. Alkaloids, flavonoids, tannins, phenols, steroids, glycosides, terpenoids, and saponins were all found in the samples (Table 1). Secondary metabolites such as alkaloids, phenols, flavonoids, saponins, and tannins are significant secondary metabolites that are responsible for the therapeutic properties of the plant. Secondary metabolites such as tannins, flavonoids, alkaloids, Saponins, terpenes etc.are important, therefore phytochemical analysis Many plant chemicals, like as alkaloids, saponins, flavonoids, stimulants, tannins, and others, have been discovered in phytochemical investigations and may be responsible for pharmacological activities. Alkaloids, sugars, glycosides, flavonoids, phenols, terpenoids, tannins, saponins, terpenoids, phenols, and phytosterols are the primary phytochemicals found in *Taraxacum officinale*. Alkaloids, glycosides, carbohydrates, flavonoids, phenols, terpenoids, phenols, phytosterols, and starches are the primary phytochemicals identified in *Geranium Wallicianum*. Alkaloids, flavonoids, phenols, starches, and terpenes are the primary phytochemicals identified in *Elaeagnus parvifolia*. Alkaloids are basic in nature due to the presence of nitrogen. Alkaloids have a widespread role in medicine. Important roles of alkaloids are e.g., aconitine has been used in the treatment of rheumatism, neuralgia, and sciatica, atropine asanti-spasmodic and is used in arrhythmia, cocaine as epitasis), codeine as antitussives and analgesic. vincristine and Taxol as anti-cancerous, Theophylline and Sanguinarine in

bronchitis and asthma, reserpine in hypertension, morphine as a potent analgesic, physostigmine, and Pilocarpine in glaucoma,etc[12]. Alkaloids such as rhynchophylline and isorhynchophylline isolated from *Uncariarhychophylla* act mainly on CVS and CNS including protection of cerebral ischemia, hypotension, and Bradycardia and anti-arrhythmia [13]. An is quinoline alkaloid called Berberine is present in *Berberis* species and widely used in Ayurveda and traditional Chinese medicine. Important action includes anti-hypertensive, anti-oxidant, anti-cancer, hepato-protective, and antimicrobial are important pharmacological actions of Berberine. Recent studies show that Berberine is also effective against depression, and diarrhea and to reduce triglycerides. Clinically Berberine is used in the management of oriental sore, congestive heart failure, hypercholesterolemia, and Diabetes mellitus [14].

Saponins possess molluscicidal activity (monodesmosidic acid, hedrogenin), blood coagulation and anti-allergic (ginsenoside), and anti-hypercholesterolemia (ticioside and ilex saponin ß-3) activity, anti-inflammatory (saikosaponin), anti-diabetic action (christinin A and ginsenoside) [15]. Other important actions include anti-cancer activity i.e. Cytotoxic (tubeisomide, astragaloside, and sarasinosides), anti-tumor (ginsenoside and glycosides of mediagenic acid), anti-mutagenic (glycyrrhizin), immuno-modulatory (quillaic acid), anti-viral (protoprimulagenin), anti-hepatotoxic (ginsenoside), anti-fungal activities (diosgenin and pennogenin). Saponins also possess the following important effect on the central nervous system e.g., ginseng possesses anti-stress, improves physical and mental health and sedative effect (Jujubogenin-3-0-glycosides). Saponins are an excellent choice for the treatment of fungal and yeast infections due to their natural ability to repel microorganisms. These chemicals act as natural antibiotics, helping the body fight infections and microbial attacks [16]. Flavonoids are a group of polyphenolic compounds widely distributed in plants. They are widely used in medicine for the maintenance of capillary integrity. They also inhibit enzymes e.g., aldose reductase, Cyclooxygenase, xanthine oxidase, phosphodiesterases and lipoxygenase. They possess free radical scavenging activity and are potent anti-oxidants. Many flavonoids provide protection against cardiovascular mortality and against allergy. They also inhibit the growth of cancer cell lines and anti-atherosclerotic potential [17]. Flavonoids possess radical scavenger, anti-leukemic, and vasodilator activity. They are useful for Alzheimer's disease and for improving blood circulation in the brain, anti-cancer, anti-aging and anti-bacterial are other properties shown by flavonoids [18]. Another very important role of flavonoids is that they are used as; Neutraceuticals. The flavones and catechins are the most powerful flavonoids against reactive oxygen species. Quercetin, Rutin, and Kaempferol are anti-oxidants and play a protective role in liver diseases, cataracts, and cardiovascular diseases. Quercetin protects against liver perfusion in ischemic liver disease.

Other pharmacological actions include anti-diabetic (quercetin), anti-ulcer (Hesperidin), anti-atherosclerosis, cardioprotective, anxiolytic (6-bromoflavone), anti-inflammatory (myricetin),and anti-neoplastic are other important activities of flavonoids [19]. Flavonoids protect against allergies, inflammation, free radicals, platelet aggregation, bacteria, ulcers, hepatotoxins, viruses, and cancers in addition to their antioxidant properties []20]. Plants' therapeutic value is determined by particular compounds that have physiological impacts on humans. Many phytochemicals have been discovered to have a variety of actions that can help in the prevention of chronic illness. for example, Alkaloids, protect against chronic illness. Saponins contain antibodies and protect against hyperlipidemia. Analgesic properties are found in steroids and triterpenoids. The central nervous system is regulated by steroid and saponin hormones. The significance of alkaloids, saponins, and tannins in the form of antibiotics used to treat infectious conditions was recently reported by alkaloids found in 10 plants [21]. Bitter herbs have alkaloids that can decrease headaches associated with high blood pressure [22], and as previously stated, bitter herbs contain alkaloids that can reduce headaches associated with high blood pressure. Phytochemical research has indicated the presence of a number of phytochemicals, including alkaloids, saponins, flavonoids, stimulants, tannins, and others, which might be used for a variety of medical purposes. Phytochemical compounds such as tannins, flavonoids, alkaloids, and some other aromatic compounds or secondary metabolites of the plant act as a protective mechanism against many microorganisms, insects, and herbivores. The pharmacological properties of medicinal plants may be due to the presence of two different metabolites such as alkaloids, flavonoids, glycosides, phenols, saponins, steroids, etc. It's important to understand that steroid chemicals are significant and appealing in the pharmacy because of their relation to sex hormones [22].

CONCLUSION

Using chromatographic and spectroscopic methods, the current work leads to future research in the separation and identification of the active compound from the selected plants. In the next step, these plants will be analyzed for their antioxidant and hepatoprotective activities on cell lines and animal models.

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Table 1: Preliminary qualitative phytochemical analysis of *Taraxacum officinale, Geranium wallichianum* and *Elaeagnus parvifolia*

Phytochemical Class	Reagents	Indication	*Taraxacum officinale*	*Geranium wallichianum*	*Elaeagnus parvifolia*
Alkaloids	Dragendorff's reagent	Reddish brown ppt's	+ve	+ve	+ve
	Mayer's reagent	Creamy precipitate	+ve	+ve	+ve
	Wagner's reagent	Reddish brown ppt's	+ve	+ve	+ve
Saponins	Froth test	Persistent froth	+ve	-ve	-ve
	Castor oil test	White emulsion	+ve	-ve	-ve
	Lead acetate test	White ppt's	+ve	-ve	-ve
Flavonoids	Shinoda's' test	Red or pink color	+ve	+ve	+ve
	Alkaline regent test	Yellow color	+ve	+ve	+ve
	$AlCl_3$ test.	Yellow ppt's	+ve	+ve	+ve
Tannins	$FeCl_3$ test	Black color appear	+ve	-ve	-ve
	Gelatin test	Green black color	+ve	-ve	-ve
Steroids	H_2SO_4 test.	Red color in lower layer.	+ve	-ve	-ve
Carbohydrates	Fehling's test	Brick red ppt's	+ve	+ve	-ve
Coumarins	NaOH test	Yellow fluorescence under UV	+ve	+ve	+ve
Glycosides	Keller Killani test	Brown ring	+ve	+ve	-ve
Terpenoids	Salkowski test	Reddish brown color	-ve	+ve	-ve
Phenols	Liebermann's test	red, green, or blue color.	+ve	+ve	+ve
	Ferric Chloride Test	Blue-black color	+ve	+ve	+ve
Phytosterols	Salkowski's Test	Golden yellow color	+ve	+ve	-ve
	Libermann Burchard's Test	Green color	+ve	+ve	+ve
Proteins	Xanthoprotic Test	Blue color	-ve	+ve	-ve
Diterpenes	Copper acetate Test	emerald green color	-ve	+ve	+ve
Starch	Iodine test	blue-black speck	-ve	+ve	+ve

(+ve) Indicate the presence of phytochemicals and (-ve) indicate the absence of phytochemicals.

Table 2: Analysis of phytochemical variance between the three species Showed that the species has significant differences between the various phytochemicals listed in Table 1 at p=0.074

ANOVA						
Source of Variation	*SS*	*Df*	*MS*	*F*	*P-value*	*F crit*
Between Species	1.166667	2	0.583333	0.0074	0.074208	3.284918
Within Species	6.833333	33	0.207071			
Total	8	35				

(a) **(b)** **(c)**

Figure 1. Photograph of species (a)*Taraxacum officinale (b) Geranium wallichianum (c) Elaeagnus parvifolia*

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RESEARCH ARTICLE

Emotions and Body Vitals Detection using RGB and Thermal Images Implemented in Smart Street Lights through Machine Learning Techniques

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ABSTRACT

In smart cities, the street lights can be upgraded as smart street lights that can act as the security surveillance system and also as health monitoring system. Most of the surveillance system uses the Visual Light Sensing Technology to capture the motion and records the same. This paper proposes a wireless sensing method installed in the street light that captures the human body vitals such as heart pulse rate (HPR), Respiratory speed rate (RSR), blood pressure (BP), and specific body temperature (SBT) using incoherent light emitted from human body. The proposed system uses visual light RGB camera and Thermal camera for image capturing. Data collection and processing unit, digital signal processing algorithms that converts the slightest variation in reflected light from the human body into appropriate measurements of body vitals. The collected information is compared with the threshold value of the normal body vital and triggers an alert if the vitals are beyond normalcy using Convolutional Neural Network (CNN). The physical and the physiological distress condition of the human that is within the street light range will be detected and used for evaluating the seriousness of the distress condition. This smart street light acts as a security system in case if a person is under physical threat or as a health alert system in the case of abnormal body vitals during high humidity and sun strokes atmosphere.

Keywords: Thermal camera, Body vitals, CNN, Physiological distress, Smart Street Light.

INTRODUCTION

Stress is a natural reaction of the human body that occurs when a particular abnormal situation occurs. This situation can arise due to external threat caused by other humans that can trigger the body vitals. Due to those the human body vitals will fluctuate drastically. There can be another situation such as very huge change in the environmental

temperature that leads to sun stroke, breathlessness and other complications related to blood pressure and pulse rate. In both the cases when a person is in the vicinity of smart street lights, the human images are captured through thermal camera, face features are extracted and analysed through Machine Learning algorithms to measure the Heart Pulse Rate (HPR), Blood Pressure (BP) and Specific Body Temperature (SBT). The emotional and physiological distress either due to a threat like chase and run or due to the health quotient can be notified as an alert. Researchers have been experimenting with non-invasive methods to detect stress in recent years. One of the well-established stress markers is skin temperature, which is based on physiological cues. The amount of heat emitted by the body can be used to determine the temperature of the human skin. Under typical conditions, healthy people's body temperatures ranged from 35.5 to 37.7 degrees Celsius. The human body can maintain a constant body temperature by regulating it. A noticeable increase in core body temperature could suggest a disease such as fever or hypothermia, as well as a shift in human emotions due to fear or anxiety. Remote photoplethysmography (rPPG) [1] is a method of measuring physiological signals without the need of sensors. It just requires video captured with a high-resolution camera to measure physiological signals in humans. The RGB camera monitors blood volume pulse by detecting changes in light absorption from human facial areas (BVP) [2]. To assess the rate of respiration, The Infrared Thermometer (IRT) monitors the change in temperature near the nostrils or mouth that happens as a result of breathing.

New forms of accessible and flexible thermal sensors, such as handheld thermal sensors that are lightweight, low-cost, and have great resolutions, have been made possible by thermal system advancements [3]. As a result, researchers are investigating thermal imaging in laboratories and in real-world settings for a number of applications, including human stress recognition. From a psychophysiological aspect, the autonomic nervous system oversees synchronising human physiological signals such as heart rate, breathing rate, blood perfusion, and body temperature during a stressful situation. The temporal temperatures of the face can be measured via thermal imaging [4]. The use of thermal imaging to detect stress in a non-contactless manner is a viable option. Studies have demonstrated that thermal images offer numerous advantages over RGB images when compared to visual (RGB) images. The colour and shape of a person's skin, as well as their facial features, are all unique. The accuracy of the data could be affected by structure, texture, ethical contexts, cultural distinctions, and sight. Machine Learning technique namely, Convolutional Neural Network is implemented to recognize the pattern and classify the captured images. This research paper is concentrates on explains two aspects: body vital measurement and Face detection to identify the emotions. A smart street light with the image capturing panel at the height of 10 feet approximately. The control panel that implements Machine Learning algorithm for classification can be designed at the height of 6 feet so that it can sense and triggers alarm during unprecedented situation.

Proposed System

This section explains the proposed system using visual-based methodologies and CNN classification algorithm. Changes in lighting have an impact on visual-based systems as well. In unregulated situations, visual-based imagination techniques have poor recognition precision. Thermal imaging, on the other hand, is light-resistant and can be employed in low-light situations. Thermal imaging has been employed by researchers to gauge transient temperature [5] esteems from a specified facial region in order to detect the stress condition. Victims' facial thermal signatures are measured when stress stimulation is delivered that cause them to become stressed. Then, using the pre-processing and feature extraction approach, facial features are extracted and classified using a CNN classification procedure. The proposed system has two major phases. First phase is face and emotion detection through RGB and Thermal Camera. Second phase deals with measuring the body vitals like HPR, RSR, BP and SBT. Figure 1 shows the overall block diagram of the proposed system. The overall working of the proposed system is explained as follows:

Phase 1

Image captured using RGB (visual light images) and Thermal camera (Thermal images).

Phase 2
Acquire Heart Rate Signal (HRS) from RGB images. The average HRS for a person in anxiety ranges between 126 to 153 bpm during panic attack.

Phase 3
Acquire Respiratory Rate Signal from Thermal images. The average inhalation and exhalation rate during stress is 40 to 60.

Phase 4
Trigger an alert if the vital measurements surpass the normal vital signs and lies between the average measurements due to panic attack.

Face Detection in Thermal-Based Image
Face recognition, based on the facial thermal picture, is the initial step in stress detection. Thermal pictures are often employed in a variety of situations where normal perception is limited, hampered, or insufficient, for example, during fugitive searches and surveillance at night. The thermal image's facial detection method was ineffective at first, and it was not much better for visual RGB photographs. This has been noted in many research [6] as a constraint that has an impact on the experiment approach and results. During the data collecting phase, several stress detection mechanisms limit head movement. This is due to the fact that thermal imaging has limits when it comes to multiple head motions. Face detection in the domain of stress detection based on the thermal image often employs knowledge-based techniques with invariant facial approaches, template matching methods, appearance-based methods, colour information, and fusion with visible spectrum imaging. This proposed research work has been implemented in Python as a programming language and OpenCV as a library framework to do signal processing. This tool has been chosen since it provides an integrated infrastructure for machine learning and computer vision techniques. The implementation of this work has been simulated through OpenCV using live images. Figure 2 depicts the workflow of the proposed system. The stages involved in image acquisition and feature extraction is explained below.

Stage 1: Thermal Image Capturing
The acquisition of a thermal picture from a thermal camera starts the image processing stage. In signal processing, especially related to images, the resolution and number of images that run in one second, or frames per second (FPS), are critical. Two important criteria about thermal images are (i) accuracy in temperature, reflects the nearness of the images with respect to the specific value viewed in the thermal images and (ii) the thermal sensitivity, difference in the temperature that a thermal camera is detecting. Radiometric calibration method is used to adjust the thermal temperature differences.

Stage 2: Image pre-processing and filtering
The image frame is pre-processed in its entirety. Image cleansing and pre-processing is accomplished by Gaussian Filter method [7] to adjust the image dimensions or size, convert the number of frames per second, and convert the colour channels to grayscale, bitmap, or pseudo colour.

Stage 3: Detect ROI
The RGB image is used for Region of Interest(ROI) detection. The RGB image ROI coordinates are matched to the thermal camera coordinates. Multispectral localization and pre-trained machine learning models are two ways that may be used to obtain these coordinates. The thermal image is then utilised to link these points together.

Stage 4: Tracking ROI
The Haar Cascade is a classifier that detects things that it has been trained to recognise from a source. The training result is stored in an XML file as the product. To put it simply, the Haar Cascade gets trained by superimposing a positive image over a series of negative images. Because the training requires a powerful computer, a fast internet

connection, and millions of training photographs, it is hosted on a server. To improve the efficiency of the output, use high-quality photographs and number of phases are increased for which the classifier is trained.

Stage 5: Digital signal Extraction and Face Detection

In this proposed work, the LBPH (Local Binary Patterns Histograms) Algorithm is employed to detect faces and emotions. It divides pixels in a picture into categories by thresholding each pixel's surroundings and turning the result to a binary integer. Four variables are used in LBPH:

(i) Radius: The radius is used to construct the circular local binary pattern and represents the radius surrounding the centre pixel.

(ii) Neighbours: the total number of sample points necessary to create the circular local binary pattern.

(iii)Grid X is the number of horizontally aligned cells in the grid.

(iv) Grid Y: the number of cells that are vertically aligned.

The model is trained with the faces that have been assigned a tag, and then test data is given to the machine, which decides the appropriate label as shown in Figure 4 and Figure 5.

Stage 6: Face Feature (emotion) Extraction

Next the emotions in the face are detected using Computer Vision methods [8] that can recognise and articulatethe emotion feeling based on the facial expressions. It can detect human emotions, such as anger, happiness, sadness, and so on. Each frame of the video feed is subjected to the Haar cascade algorithm, which detects faces. Convolutional neural network (CNN) algorithm is implemented to train the system to detect the emotions in the face area. The image that contains the face region is resized to 48x48 pixel before being fed into the CNN. For each of the seven emotion classes, the network generates a list of SoftMax scores that converts the pixel values into a vector of values summed up to 1. The values lies between 0 and 1 that can be deduced as probability for a certain emotion. The emotion with the highest score is captured and displayed on the screen. Figure 6: shows the emotion that has been detected as 'Normal' and displayed. Figure 7: depicts the emotion as Fearful, this triggers the alarm to measure the body vitals to analyse the stress level experienced by the individual. By default, this system recognises all the faces in the camera feed as having emotions. Using a simple 4-layer CNN, the test accuracy was 70 percent in 50 epochs. Figure 8 shows the accuracy rate of emotion detection trained by the proposed system.

Body Vital Measurement

To capture the body vitals of the human with in the vicinity of the smart street lights, a contact –less thermal imaging processing is implemented in the proposed system. The inhalation and exhalation ratio is extracted from the thermal images. This is accomplished by using the intensity of the light around the nostrils and mouth area. The rate of respiration (measured in breaths per minute, or bpm) within a minute is referred to as Respiration Rate(RR). An RR of 12–20 bpm is considered normal for mature people. According to study [9], a 5 percent increase in mortality risk is associated with a small rise in breaths per minute to 24–28.The thermal camera is undoubtedly a feasible solution for creating a non-contact RR counter. In a thermal picture, which is a temperature representation translated into an image matrix, there is just one information channel. This information alone can be used to create a respiratory signal. The there are two fluctuations that can be seen: one is a change in temperature, and the other is a change in movement. Figure 9 explains the process of extracting the signal from the thermal image that performs two operations. First, it measures the temperature change near the frontal mouth and nostril area, secondly it observes the transition created due the variation in pixels in every frame. The change in temperature surrounding the nostril that indicates breathing. The proposed system uses the Multiple Signal Classification (MUSIC) algorithm [10] to calculate the estimated Respiratory Speed Rate (RSR) that is more accurate to convert into time series values. The correlation matrix is created from the data calculated through time series. The Eigenvectors are acquired from this matrix calculation. Figure 10, 11,12 shows the thermal images with the change in light intensity near the nostril and mouth region which explains that inhalation and exhalation are happening. The proposed system has been implemented in Open CV libraries using CNN. For experimental purpose still images are used captures through RGB and thermal cameras.

CONCLUSION AND FUTURE ENHANCEMENT

The novel idea of converting the smart street lights as security and health monitoring device can be made into practicality by upgrading the proposed system in terms of accuracy and robustness. Human images in the surrounding area of these high lights equipped with thermal camera (single or multiple) can be very well utilized to measure the emotions and specific body vitals. OpenCV libraries and Machine learning techniques like Haar cascade classifiers, Local Binary Patterns Histograms and CNN are trained to measure the body vitals, detect the face and its respective emotions. The result of this classification techniques that exceeds the normal values indicates that the human in the vicinity is experiencing threat either due to external factors or in distress due to extreme physiological body condition. An alert can be triggered to rescue the person under threat in either cases. This proposed work can be improved in many aspects like optimizing the training set using predefined common data sets, testing through live thermal videos and applying noise reduction techniques during image capturing.

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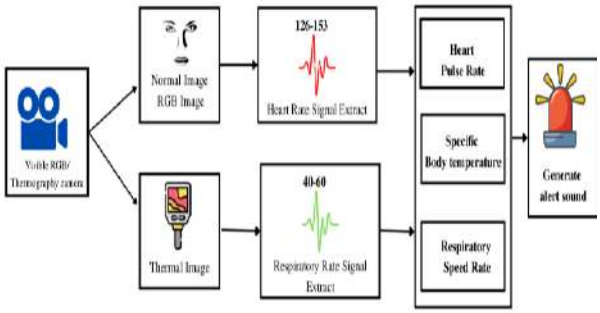

Figure 1: Image capturing through Thermal and RGB camera to measure body temperature, respiration rate and heart beat rate

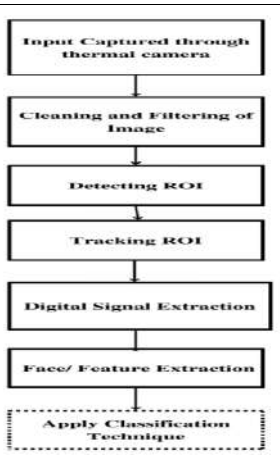

Figure 2: Stages involved in measuring the vitals using thermal camera.

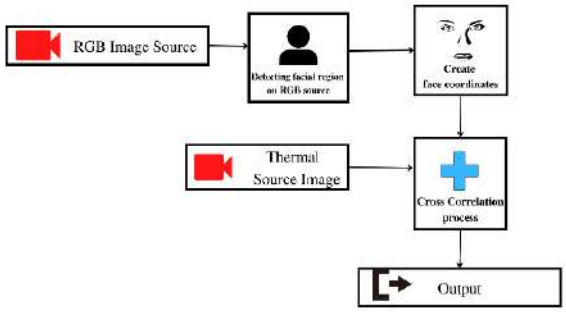

Figure 3: An explanation of RGB cameras that aid in the ROI and transformation process of thermal cameras.

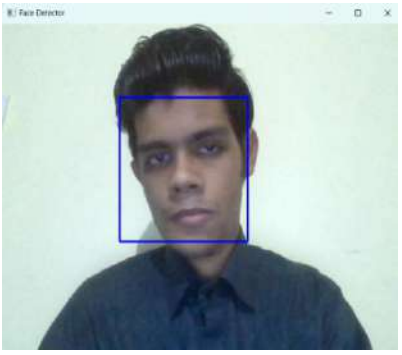

Figure 4: shows the face detection implemented using LBPH algorithm.

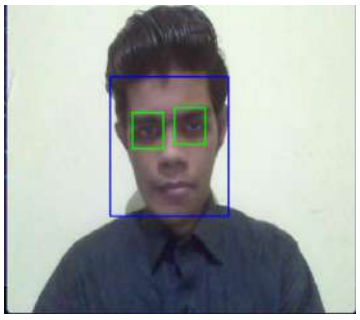

Figure 5: shows the face detection implemented using LBPH algorithm.

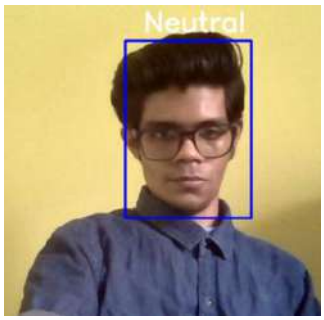

Figure: 6 Face detected as "Neutral"

Figure 7: Face Detected as "Fearful"

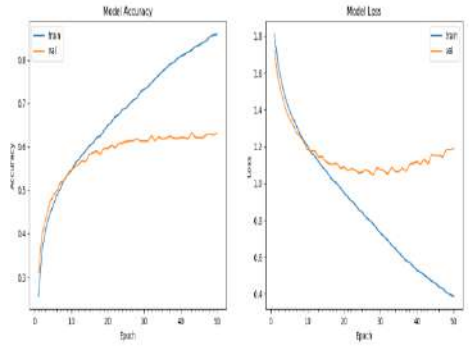

Figure 8: Test Accuracy rate using 4-Layer CNN

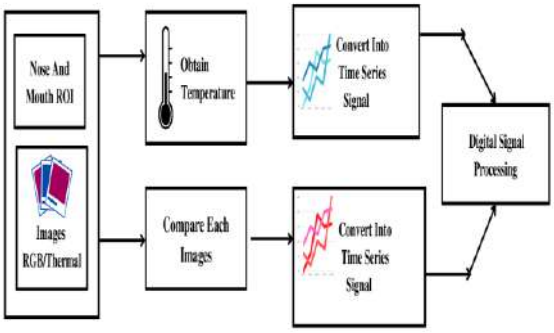

Figure 9: Depicts the Signal extracting process

Figure 10: Face detected thermal image with breathing

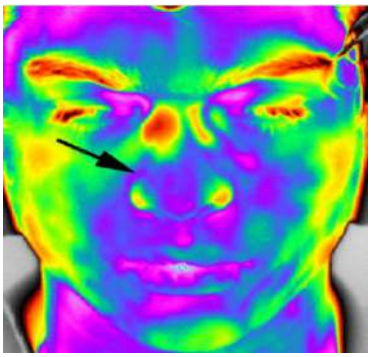

Figure 11: Face detected thermal image with inhalation and exhalation

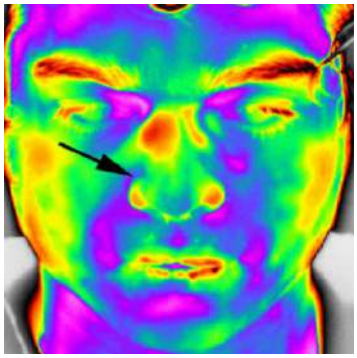

Figure 12: Face detected thermal image with inhalation and exhalation

RESEARCH ARTICLE

Weak Rupture Degree of Product Graph

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ABSTRACT

The rupture degree of a graph is a measure of vulnerability of a graph. In this paper we investigate a refinement involve the weak version of this parameter. The weak rupture degree of a connected graph G is defined by $R_w(G) = max\{\omega(G-S) - |S| - m_e(G-S): S \subseteq V(G),\ \omega(G-S) > 1\}$, where ω (G − S) is the number of the components of G-S and $m_e(G-S)$ is the number of edges of the largest component of G-S. In this paper we determine the exact values of the weak rupture degree of cartesian product of graphs namely, $P_m \square C_n$ and tensor product of graphs such as $P_m \times C_n$ and $C_m \times C_n$ where P_n is a path of order n and C_n is a cycle of order n.

Keywords: Weak rupture degree, Vulnerability, Cartesian product, Tensor product.

Subject Classification:05C38, 05C40, 05C42.

INTRODUCTION

The continuous improvement of the reliability of communication system facilities has put forward more stringent requirements on the design of computer network structure (invulnerability). Theoretically speaking, the traditional designs mainly depend on connectivity and edge connectivity of graphs. However, these two parameters only consider the difficulty of destroying the network, but do not consider the state of the network after damages. The ”vertices”, ”edges” and their incidence manner are the three major factors which directly relate to the reliability and in vulnerability of a network. The definition of weak rupture degree considers these three factors and so it is one of the ideal parameters for measuring networks and embedded system chips. Graphs are often used to model real world problems, such as problems in a communication network. The analysis of vulnerability in networks generally involves some questions about how the underlying graph is connected. When some vertices of a graph are deleted,

one wants to know whether the remaining graph is still connected. Moreover if the graph is disconnected, the number of edges of components is useful. Based on these questions, a number of graph parameters, such as connectivity[3], integrity, rupture degree[8] been proposed for measuring the vulnerability of networks. Among these parameters weak rupture degree is an important parameter to quantitatively describe the in vulnerability of networks. Let G be a finite simple graph with vertexset $V(G)$ and edgeset $E(G)$.Then the following parameters are defined.

Definition 1.1: The *rupture degree* for a connected graph G is defined to be
$r(G)=max\{\omega(G-S)-|S|-m(G-S):X\subset V(G),\omega(G-S)>1\}$,
where $\omega(G-S)$is the number of components of $G-S$ and $m(G-S)$is the order of a largest component of $G-S$.

Definition 1.2: The weak rupture degree of a connected graph G is defined to be
$R_w(G) = \max\{\omega(G-S) - |S| - m_e(G-S) : S\subseteq V(G),\ \omega(G-S)>1\}$, Where $\omega(G-S)$ is the number of the components of $G-S$ and $m_e(G-S)$ is the number of edges of the largest component of $G-S$. The weak rupture degree for a complete graph$R_w(K_n)=2-n$.

Definition 1.3: Let G be an incomplete connected graph, a set$S\subseteq V(G)$ is called anR_w *-set* if it satisfies$R_w(G) = \omega(G-S) - |S| - m_e(G-S)$.

Definition 1.4: The *Cartesian product* of the graphs G and H, denoted by G □ H, has the vertexset V (G □ H)=V (G) × V (H)and(u, x)(v, y)is an edge of G □ H if(i)u=v and xy∈E(H)or,(ii)x=y and uv∈E(G).

Definition 1.5: The *tensor product* of the graphs G and H, denoted by $G\times H$, has the vertex set
$V(G\times H) = V(G)\times V(H)$ and $E(G\times H)$= {(u,x)(v,y): uv∈E(G) and xy∈E(H)}.

Notation and definitions which are not given here can be found in [2] and [3].In this paper we determine the exact values of the weak rupture degree of Cartesian product of graphs namely,$P_m\square C_n$and tensor product of graphs such as$P_m\times C_n$and$C_m\times C_n$ where$P_n$isapathoforder$n$and$C_n$is a cycle of order n.Let $\alpha(G)$ denote the independence number and $\beta(G)$ denote the covering number.

Weak rupture degree of cartesian product of a path and a cycle
In this section we calculate the weak rupture degree of cartesian product of a path and a cycle.

Theorem2.1.[9]IfGisagraphoforder$n$,independencenumber$\alpha(G)$andcoveringnumber$\beta(G)$.Then
$R_w(G)\geq\alpha(G)-\beta(G)$

Theorem2.2.[9]Let G be a connected graph. Then
$R_w(G)\leq r(G)+1$
The following proposition can be easily observed in $P_m\square C_n$,m≥2,n≥3.

Proposition2.3. IfSbeanR_w-setof$P_m\square C_n$, m≥2,n≥3.Thenthecomponentsof $P_m\square C_n-S$mustbeK_1orK_2orboth.

Proposition2.4. LetSbeaminimalR_w -setof $P_m\square C_n$,m≥2,n≥3,theninP$_m\square C_n-S$,

1. if n is even there exists at most $\left\lceil\frac{mn}{2}\right\rceil$ number of K_1. There is no K_2 in this cases.
2. if m and n are both odd there exists at most $\left\lceil\frac{m}{2}\right\rceil$ number of K_2.
3. If m is even and n is odd there exists at most $\left\lceil\frac{m}{2}\right\rceil$ number of K_2.

Theorem 2.5. If $m\geq 2$, $n\geq 3$, then the weak rupture degree of $P_m\square C_n$is

$$R_w(P_m \square C_n) = \begin{cases} 0 & if\ n\ is\ even, \\ -\left\lceil \frac{m}{2} \right\rceil & if\ m\ and\ n\ are\ both\ odd, \\ -\frac{m+2}{2} & if\ m\ is\ even\ n\ is\ odd. \end{cases}$$

Proof: Let $G=P_m \square C_n, m\geq 2, n\geq 3$.

Case1: n is even.

For $1\leq i\leq m$ and $1\leq j\leq n$,

let $S=\{(u_i, v_j) \mid$ i is even and j is odd or i is odd and j is even.$\}$

Then $|S|=\left\lceil \frac{mn}{2} \right\rceil$, $\omega(G-S)=\left\lceil \frac{mn}{2} \right\rceil$ and $m_e(G-S)=0$.

Hence

$\omega(G-S)-|S|-m_e(G-S) \geq \frac{mn}{2}-\frac{mn}{2}-0$

$R_w(G) \geq 0$ (1)

On the other hand, by Proposition 2.4, we know that there exist at most $\left\lceil \frac{mn}{2} \right\rceil = \frac{mn}{2}$ number of K_1, and they are located at the same position of non adjacent cycles in G-S. We have

$|S| \geq \left\lceil mn - \frac{mn+1}{2} \right\rceil = \left\lceil \frac{mn-1}{2} \right\rceil = \frac{mn}{2}$,

$\omega(G-S) \leq \left\lfloor mn - \frac{mn-1}{2} \right\rfloor = \left\lfloor \frac{mn+1}{2} \right\rfloor = \frac{mn}{2}$ and $m_e(G-S)=0$.

Therefore

$\omega(G-S)-|S|-m_e(G-S) \leq \frac{mn}{2}-\frac{mn}{2}-0$

$R_w(G) \leq 0$ (2)

From (1) and (2)

$R_w(G) = R_w(P_m \square C_n) = 0$

Case2: m and n are both odd.

For $1\leq i\leq m$ and $1\leq j\leq n$,

let $S=\{(u_i, v_j) \mid$ i is even and j is odd or i is odd and j is even.$\}$

Then $|S|=\frac{mn-1}{2}$, $\omega(G-S)=\frac{m(n-1)}{2}$ and $m_e(G-S)=1$.

Hence

$\omega(G-S)-|S|-m_e(G-S) \geq \frac{m(n-1)}{2}-\frac{mn-1}{2}-1$

$R_w(G) \geq -\frac{m+1}{2} = -\left\lceil \frac{m}{2} \right\rceil$. (3)

On the other hand, by Proposition 2.4, we know that there exist at most $\left\lceil \frac{m}{2} \right\rceil = \frac{m+1}{2}$ number of K_2, in G-S and the other components are all K_1. We have

$|S| \geq \left\lceil \frac{mn - \frac{m+1}{2}2}{2} \right\rceil = \left\lceil \frac{mn-m-1}{2} \right\rceil$.

But, in order to get at most $\frac{m+1}{2}$ number of K_2, we must delete atleast $\frac{m-1}{2}$ number of K_2 from G and so we have

$|S| \geq \left\lceil \frac{mn - \frac{m+1}{2}2}{2} \right\rceil + \frac{m-1}{2} = \frac{mn-1}{2}$,

$\omega(G-S) \leq \frac{m+1}{2} + \left\lceil \frac{mn - \frac{m+1}{2}2}{2} \right\rceil - \frac{m-1}{2} = \frac{mn-m}{2}$ and $m_e(G-S) = 1$.

Therefore

$R_w(G) \leq \frac{mn-m}{2} - \frac{mn-1}{2} - 1 = -\frac{m+1}{2} = -\left\lceil \frac{m}{2} \right\rceil$ (4)

From (3) and (4)

$R_w(G) = R_w(P_m \square C_n) = -\left\lceil \frac{m}{2} \right\rceil$

Case 3: mis even and n is odd.

For$1 \leq i \leq m$and$1 \leq j \leq n$,

let$S=\{(u_i, v_j) | \text{i is odd and j is odd or i is even and j is even.}\}$

Then $|S| = \frac{mn}{2}$, $\omega(G-S) = \frac{m(n-1)}{2}$and $m_e(G-S) = 1$.

Hence

$\omega(G-S) - |S| - m_e(G-S) \geq \frac{m(n-1)}{2} - \frac{mn}{2} - 1$

$R_w(G) \geq -\frac{m+2}{2}$. (5)

Ontheotherhand,byProposition2.4,weknowthatthereexistatmost $\left\lceil \frac{m}{2} \right\rceil = \frac{m}{2}$ number of K_2, in G-S and the other components are all K_1. We have

$|S| \geq \left\lceil \frac{mn - \frac{m}{2}2}{2} \right\rceil = \left\lceil \frac{mn-m}{2} \right\rceil$.

But, in order to get at most $\frac{m}{2}$ number of K_2, we must delete atleast $\frac{m}{2}$ number of K_2 from G and so we have

$|S| \geq \left\lceil \frac{mn-m}{2} \right\rceil + \frac{m}{2} = \frac{mn}{2}$,

$\omega(G-S) \leq \frac{m}{2} + \left\lceil \frac{mn - \frac{m}{2}2}{2} \right\rceil - \frac{m}{2} = \frac{mn-m}{2}$ and $m_e(G-S) = 1$.

Therefore

$R_w(G) \leq \frac{mn-m}{2} - \frac{mn}{2} - 1 = -\frac{m+2}{2}$ (6)

From (5) and (6)

$R_w(G) = R_w(P_m \square C_n) = -\frac{m+2}{2}$

Weak rupture degree of Tensor product of some graphs

In this section we obtain the weak rupture degree of tensor product of graphs such as $\mathbf{P_m \times C_n}$ and $\mathbf{C_m \times C_n}$.

Theorem 3.1. The weak rupture degree of $P_m \times C_n$, m≤n, m≥ 2 *and* $n \geq 3$ *is*

$R_w(P_m \times C_n) = \begin{cases} 0 \; if \; m \; is \; even, \\ n \; if \; m \; is \; odd \; . \end{cases}$

Proof: Let $G = P_m \times C_n$ and S be a vertex cut of G and |S|=t. We distinguish two cases.

Case 1: m is even and n is even or m is even and n is even.

If $2 \leq t \leq \frac{mn}{2}$, then we have $\omega(G-S) \leq t$ and $m_e(G-S) \geq 0. Thus$

$\omega(G-S) - |S| - m_e(G-S) \leq t - t$

$$R_w(G) \leq 0. \tag{7}$$

If $t \geq \frac{mn+2}{2}$, then we have $\omega(G-S) \leq mn - t \; and \; m_e(G-S) \geq 0. Thus$

$\omega(G-S) - |S| - m_e(G-S) \leq mn - t - t$

The function f(t)=mn-2t is a decreasing function and attains its maximum value at $t=\frac{mn+2}{2}$. Thus,

$f\left(\frac{mn+2}{2}\right) = mn - 2\left(\frac{mn+2}{2}\right) = -2 \leq 0$

We get

$$R_w(G) \leq 0. \tag{8}$$

By (7) and (8) we have

$$R_w(G) \leq 0. \tag{9}$$

On the other hand, it is easily seen that $\alpha(G)=\frac{mn}{2}$. By Theorem 2.1 we have

$$R_w(G) \geq \alpha(G) - \beta(G)$$

$$R_w(G) \geq \left(\frac{mn}{2}\right) - \left(\frac{mn}{2}\right)$$

$$R_w(G) \geq 0. \tag{10}$$

By (9) and (10) we have

$$R_w(G) = R_w(P_m \times C_n) = 0.$$

Case 2: m is odd and n is even or m is odd and n is odd.

If $2 \leq t \leq \frac{mn-1}{2}$, then we have $\omega(G-S) \leq t+n$ and $m_e(G-S) \geq 0.$ Thus

$\omega(G-S) - |S| - m_e(G-S) \leq t + n - t$

$$R_w(G) \leq n. \tag{11}$$

If $t \geq \frac{mn-n+2}{2}$, then we have $\omega(G-S) \leq mn - t$ and $m_e(G-S) \geq 0.$ Thus

$\omega(G-S) - |S| - m_e(G-S) \leq mn - t - t$

The function f(t)=mn-2t is a decreasing function and attains its maximum value at $t=\frac{mn-n+2}{2}$. Thus,

$f\left(\frac{mn-n+2}{2}\right) = mn - 2\left(\frac{mn-n+2}{2}\right) = n \leq 0$

We get

$R_w(G) \leq n.$ (12)

By (11) and (12) we have

$R_w(G) \leq n.$ (13)

On the other hand, it is easily seen that $\alpha(G)=\frac{mn-n}{2}$. By Theorem 2.1 we have

$R_w(G) \geq \alpha(G) - \beta(G)$

$R_w(G) \geq \left(\frac{mn+n}{2}\right) - \left(\frac{mn-n}{2}\right)$

$R_w(G) \geq n.$ (14)

By (13) and (14) we have

$$R_w(G) = R_w(P_m \times \mathrm{C_n}) = n.$$

Theorem 3.3[12]If m,n ≥ 3 and both m and b are odd or they are different parity, then the rupture degree of $\mathrm{C_m} \times \mathrm{C_n}$is

$$r(C_m \times \mathrm{C_n}) = \begin{cases} max\{-m-1,-n-1\} & if\ m\ and\ n\ are\ odd. \\ -1 & if\ m\ and\ n\ are \text{ different parity} \end{cases}$$

Theorem 3.3 If m,n≥3 then the weak rupture degree of $\mathrm{C_m} \times \mathrm{C_n}$is

$$R_w(C_m \times \mathrm{C_n}) = \begin{cases} max\{-m-1,-n-1\} & if\ m\ and\ n\ are\ odd. \\ 0 & if\ m\ and\ n\ are \text{ different parity} \end{cases}$$

Proof: LetG=$C_m \times \mathrm{C_n}$, where m≥3 and n≥3.

Case 1:m and n are odd.

Let m≥n. Then by Theorem 3.2, r(G)= -n-1. By Theorem 2.4,

$R_w(G) \leq r(G) + 1$

≤-n -1+1

≤ -n (15)

If m≥n, it is clear that β(G)=n$\left\lceil\frac{m}{2}\right\rceil$,$\alpha(G)$ =n$\left\lfloor\frac{m}{2}\right\rfloor$. Then by Theorem 2.1,

$R_w(G) \geq \alpha(G) - \beta(G)$

≥ n$\left\lfloor\frac{m}{2}\right\rfloor$ − n$\left\lceil\frac{m}{2}\right\rceil$= -n (16)

Hence from (15) and (16),

$R_w(G) = -n.$ (17)

Similarly if n≥m, then

$R_w(G) = -n.$ (18)

and hence by (17) and (18),

$R_w(G) = max\{-n, -\text{m }\}.$ (19)

Case 2:m is even and n is odd.

By Theorem 3.2, r(G)= -1. By Theorem 2.4,

$R_w(G) \leq r(G) + 1$

≤-1+1

≤ 0 (20)

It is clear that β(G)=n$\left\lceil\frac{m}{2}\right\rceil$, $\alpha(G)$ =n$\left\lfloor\frac{m}{2}\right\rfloor$. Then by Theorem 2.1,

$$R_w(G) \geq \alpha(G) - \beta(G)$$

$$\geq \text{n}\left\lfloor\frac{m}{2}\right\rfloor - \text{n}\left\lceil\frac{m}{2}\right\rceil = 0 \quad (21)$$

Hence from (20) and (21),

$R_w(G) = 0.$ (22)

Case 3:m is odd and n is even.

By Theorem 3.2, r(G)= -1. By Theorem 2.4,

$$R_w(G) \leq r(G) + 1$$

≤-1+1

≤ 0 (23)

It is clear that β(G)=m$\left\lceil\frac{n}{2}\right\rceil$, $\alpha(G)$ =m$\left\lfloor\frac{n}{2}\right\rfloor$. Then by Theorem 2.1,

$$R_w(G) \geq \alpha(G) - \beta(G)$$

$$\geq \text{m}\left\lfloor\frac{n}{2}\right\rfloor - \text{m}\left\lceil\frac{n}{2}\right\rceil = 0 \quad (24)$$

Hence from (20) and (21),

$R_w(G) = 0.$ (25)

CONCLUSION

If we want to design a communications network, we wish it as stable as possible. Any communication network can be modeled by a connected graph. In graph theory, we have many stability measures such as connectivity, toughness, integrity and tenacity. The weak rupture degree is a parameter which measures the vulnerability of a graph G. From the above study, we observe that exact values of weak rupture degree of Cartesian product and tensor product are discussed.hen we design two networks which have the same number of processors, if we want to

choose the more stable one from two graphs with the same number of vertices, it is enough to choose the one whose weak rupture degree is greater.

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RESEARCH ARTICLE

Antidiabetic Activity of Hydromethanolic Leaf Extract of *Schweinfurthia sphaerocarpo*

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ABSTRACT

One of the major global health crises, diabetes mellitus calls for novel treatment modalities as well as preventive strategies. It is currently vital to identify new anti-diabetic drugs that are secure, efficient, and affordable; one fascinating study topic is looking at medicinal plants for potential anti-diabetic active compounds. As a result, the current study was carried out to assess the anti-diabetic activity of *Schweinfurthia sphaerocarpo*. The dried leaves were powdered and extracted for 72 hours in 80% methanol. The extract's potential for hypoglycemic activity was analysed by inhibiting the enzymes α- amylase and α- glucosidase. The extract had a significant effect on blood glucose levels. The results indicate that *Schweinfurthia sphaerocarpo* has anti-diabetic activity.

Keywords: Anti-diabetic, Diabetes mellitus, Enzymes

INTRODUCTION

Diabetes mellitus is a metabolic disorder with multiple etiologies characterised by a failure of glucose homeostasis with disturbances in carbohydrate, fat, and protein metabolism as a result of defects in insulin secretion and/or insulin action [1].Type 2 diabetes has emerged as a major global health issue in recent years. According to the World Health Organization, this condition affects more than 176 million people worldwide [2]. Diabetes is associated with numerous of major risks, including cardiovascular disease, neuropathy, nephropathy, and retinopathy. These chronic complications may consequence in artery hardening and narrowing (atherosclerosis), which may progress to stroke, coronary heart disease, and other blood vessel diseases, nerve damage, kidney failure, and blindness over time[3].The number of persons with diabetes has surpassed 100 million worldwide, and it currently claims more lives than AIDS. Over the past two decades, there has been an increase in the occurrence of this condition, which has been linked to decreased physical activity, rising obesity, stress, and changes in food consumption[4]. Different extracts from medicinal plants have also been used traditionally to manage diabetes globally, and these are considered as relatively inexpensive, less toxic and with relatively little or no side effects[5] however the side effects of the phytotherapeutic agents are less common compared with synthetic drugs. Management of diabetes without any side effect is still a challenge and the available modern Antidiabetic agents produce serious side effects such as hypoglycaemia (Sulphonylureas), lactic acidosis and folate and B12 malabsorption (Metformin), gastrointestinal symptom (Acarbose), weight gain (Sulphonylureas and Thiazolidinedione's), and oedema (Thiazolidinedione's). Hence, the search for safer and more effective hypoglycaemic agents has continued[6]. One such plant being used by the traditionalpractitioners in Tamil Nadu to treat diabetes is*Schweinfurthia sphaerocarpo*[7].Traditionally,it is also used in the treatment of enteric fever and diuretics.The phytoconstituents present in this plant are schweinfurthin, a hydrocarbon, unsaturated ketone and two macrocylic alkaloids, epi-ephedradine and schweinine.Hence, the present experiment was undertaken to study the Antidiabetic effect for *Schweinfurthia sphaerocarpo*(Scrophulariacea).

MATERIALS AND METHODS

Plant material

The fresh leaves of *Schweinfurthia sphaerocarpo* was collected from Rajasthan and authenticated by Siddha Central Research Institute, Chennai - 106.

Preparation of plant extraction

The leaves of the plant were first thoroughly washed with distilled water and allowed to dry under shade with optimal ventilation. The dried leaves were then chopped to coarse powder. Five hundred grams of the coarse powdered plant material was macerated in 80% methanol for 72 hours and then the extract was filtered using Whatman filter paper No. 1. Then, the residue was remacerated two times with fresh solvent, each for 72 hours, and the filtrates obtained from the successive maceration were dried in a hot air oven at 40^0 centigrade. The dried extract was then kept in a desiccator to maintain dryness till used in the experiment [8].

INVITRO STUDY

Inhibition of α-amylase Enzyme

α-amylase (0.5 mg/ml) was mixed with the sample at various concentrations (100-500 µg/ml) to which 1% of starch solution and 100 µl of 0.2 mm of phosphate buffer (pH -6.9) were added. The reaction was allowed to be carried out at 37°C for 5 min and terminated by addition of 2 ml of 3, 5-dinitrosalicylic acid reagent. The reaction mixture was heated for 15 min at 100°C and diluted with 10 ml of distilled water in an ice bath. α-amylase activity was determined by measuring colour intensity at 540 nm in spectrophotometer[9 - 10].

Inhibition of α-glucosidases Enzyme

The inhibitory activity was determined by incubating 1 ml of starch solution (2% w/v maltose) with 0.2 M Tris buffer (pH 8) and various concentration of sample (100-500 mg/ml). The reaction mixture was incubated at 37°C for 10 min.

The reaction was initiated by adding 1 ml of α-glucosidase enzyme (1 U/ml) to it and incubation at 35°C for 40 min. Then the reaction was terminated by the addition of 2 ml of 6 N HCl. The intensity of the colour was measured at 540 nm in spectrophotometer[11 - 12]. The results were expressed as % inhibition using the formula:

% inhibitory activity = (Ac-As)/Ac ×100

Where, Ac is the absorbance of the control
As is the absorbance of the sample.

RESULT AND DISCUSSION

Percentage yield of the plant extract

A total of 95 grams of dark brown gummy extract was obtained at the end of the extraction process. The percentage yield of the extract was found to be 19 % W/W.

α – amylase inhibitory activity

Methanolic extract of 100, 200, 300, 400, 500 µg doses inhibits the α – amylase enzymes by 42.42%, 54.66%, 69.78%, 76.52% and 87.97%. Acarbose of 100, 200, 300, 400, 500 µg doses inhibits the α – amylase enzymes by50.91%. 61.31%, 68.23%, 74.21%, and 89.18% respectively. Dose dependent inhibition of α – amylase were observed for the both methanolic extract and the standard drug. However, methanolic extract shows the significant inhibition of α – amylase enzymes.

α-glucosidases inhibitory activity

Methanolic extract of 100, 200, 300, 400, 500 µg doses inhibits the α-glucosidases enzymes by 39.83%, 58.34%, 69.87%, 78.67% and 83.77% respec Acarbose of 100, 200, 300, 400, 500 µg doses inhibits the α-glucosidases enzymes by 47.96%, 64.89%, 77.36%, 81.27% and 88.65% respectively. Percentage inhibition of α-glucosidases enzymes were observed for both methanolic and standard drug, the methanolic extract shows the significant antidiabetic activity.

CONCLUSION

We conclude that the extract hydromethanolic leaf extract of *Schweinfurthia sphaerocarpo*tested for the *invitro* Antidiabetic have shown appreciable report in decreasing the blood glucose level by inhibiting α – amylase and α – glucosidase enzymes. This research supports by formulating the drug using phytoconstituents of this plant as a lead molecule. The fraction of this plant could serves the purpose better than the existing formulation.

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Table 1. α – amylase inhibitory activity

CONCENTRATION	% OF INHIBITION	
	STANDARD	METHANOLIC EXTRACT
100	59.91	42.42
200	61.31	54.66
300	68.23	69.78
400	74.21	76.52
500	89.18	87.98

Table 2. α-glucosidases inhibitory activity

CONCENTRATION	% OF INHIBITION	
	STANDARD	METHANOLIC EXTRACT
100	47.96	39.83
200	64.89	58.34
300	77.36	69.87
400	81.27	78.67
500	88.65	83.77

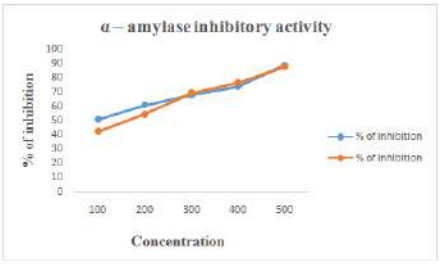

Fig :1 α – amylase inhibitory activity

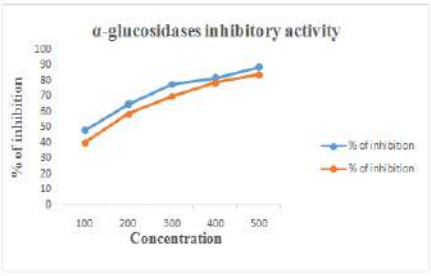

Fig: 2 α-glucosidases inhibitory activity

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RESEARCH ARTICLE

Total Antioxidant and Free Radical Scavenging Activities of Seasonally Available Red Thumb Fingerling Potato, Cultivated in South Dinajpur District, West Bengal, India

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ABSTRACT

Red thumb fingerling potato (*Solanum tuberosum*) is a natural source of anthocyanins and important antioxidants. The objective of the present study was to determine the antioxidant, free radical scavenging activities and lipid peroxidation inhibitory activities of red thumb potato (RTP) cultivars collected from different potato fields of South Dinajpur district, West Bengal. Total antioxidant activity along with the scavenging potential of DPPH radical-, hydroxyl radical-, hydrogen peroxide-, superoxide-, and nitric oxide were determined by methanolic extract RTP. Methanolic extract of RTP possesses significant amount of hydroxyl radical-, hydrogen peroxide-, and nitric oxide scavenging activities than that of the irrespective standards. The correlation between total phenolic content and DPPH radical scavenging activity indicates that phenolic compounds are responsible for antiradical activity. Principal component analysis of the present study showed that superoxide, hydrogen peroxide, reducing power and total phenolics were the most prominent factors that might enhance the antioxidant as well as free radical scavenging activities of RTP. From the present study, it can be concluded that apart from its food value, the red thumb potato can also be used for the management of oxidative stress-related neurodegenerative disorders.

Keywords: Antioxidant, DPPH, Free radicals, Phenolics, Principal component analysis

INTRODUCTION

Red thumb fingerling potato (*Solanum tuberosum*, Family: Solanaceae) (abbreviated as RTP hereafter) is small (size 6-7 cm), tubular or elliptical in shape, having ruby red semi-smooth skin. It has brown russeting along with dark brown spots spread throughout the surface. This potato variety is said to have originated in Peru. RTP variety mainly cultivated in upper Gangetic region of India especially in South Dinajpur and Malda district of West Bengal State during the winter season. The flesh is smooth and pink-creamy white colored. After cooking, RTP became purple in color with an earthy and savory flavor [1]. Pigmented potatoes are the resources of a number of phytochemicals, especially acylated derivatives of anthocyanins in its skin and tubers [2]. So far, researchers have studied the susceptibility and tolerance of red thumb potatoes to *Meloidogyne*, a root-knot nematode [3]. Red, purple, and blue-fleshed potatoes, as well as their associated products, have proven to be an appealing alternative to standard white or cream- colored potato flesh [4]. The antioxidant activity and phenolic content of white, yellow, purple and red fleshed potatoes have been investigated [5]. However, the red thumb potato variety cultivated in the upper Gangetic plain of West Bengal, especially in the South Dinajpur and Malda district, have not been investigated so far for its pharmacological properties. Therefore, the aim of the present study was to determine the antioxidant, free radical scavenging- and lipid peroxidation inhibitory activities of red thumb potato (RTP) cultivars.

MATERIALS AND METHODS

Plant Material

The fresh RTP samples were collected from local farmers of different RTP growing fields in and around Balurghat town, of South Dinajpur District, West Bengal, India in the month of December, 2021 and January, 2022.

Sample Preparation

Samples were prepared according to a previously described method [6]. Fresh RTP samples were washed thoroughly, sliced and dried at room temperature for 7 days, finely powdered, and used for extraction. The powder (20g) was double extracted with methanol (200 ml) and the extract collected from the two phases were concentrated in a rotary evaporator. The concentrated extract was then lyophilized. The residue was kept at -20^{0}C for future use.

DPPH Radical Scavenging- and Total Antioxidant Activity

DPPH radical scavenging assay was determined using a previously described procedure using α-tocopherol as a positive control [7]. The decrease in the absorbance of the reaction mixture indicated higher free radical scavenging activity. The total antioxidant capacity of the extract was evaluated according to phosphomolybdenum method where the absorbance of the final reaction mixture was measured at 695 nm against an appropriate blank solution. The higher absorbance value indicated higher antioxidant activity [8].

Hydroxyl Radical Scavenging Activity

Hydroxyl radical scavenging assay was evaluated by a standard protocol which is based on the quantification of the degradation product of 2-deoxyribose by condensation with TBA. Hydroxyl radical was generated by the Fe^{3+}-ascorbate-EDTA- H_2O_2 system (Fenton reaction) [9]. The absorbance of the final reaction mixture was measured at 532 nm against an appropriate blank solution using mannitol as a positive control.

Superoxide Radical Scavenging Activity

Superoxide radical scavenging activity of the methanolic RTP extract was determined based on the reduction of NBT according to a previously reported method [10]. The non-enzymatic phenazine methosulfate-nicotinamide adenine dinucleotide (PMS/NADH) system generates superoxide radicals that reduce nitro blue tetrazolium (NBT) into a

purple-colored formazan. The absorbance of the final reaction mixture was taken at 562 nm against an appropriate blank solution and quercetin as positive control.

Nitric Oxide Radical Scavenging Activity

Nitric oxide radical scavenging activity of the RTP extract was evaluated using Griess Illisvoy reaction, taking curcumin as the standard [11]. The pink chromophore generated during diazotization of nitrite ions with sulfanilamide and subsequent coupling with NED was measured spectrophotometrically at 540 nm against a blank sample.

Hydrogen Peroxide Scavenging Activity

H_2O_2 scavenging activity was determined according to a previously described method with minor changes [12]. An aliquot of 50 mM H_2O_2, various concentrations (0-2 mg/ml) of samples, methanol and FOX reagent were mixed, vortexed and incubated at room temperature for 30 min. the absorbance of the ferric-xylenol orange complex was measured at 560 nm. Sodium pyruvate was used as the reference compound.

Hypochlorous Acid Scavenging Activity

The assay was carried out as described previously with minor changes [13]. The scavenging activity was evaluated by measuring the decrease in absorbance of catalase at 404 nm using ascorbic acid as a reference compound. The reaction mixture contained in a final volume of 1 ml, 50 mM phosphate buffer (pH 6.8), catalase (7.2 μM), HOCl (8.4 mM) and increasing concentrations (0-100 μg/ml) of RTP extract.

Iron Chelation Assay

The ferrous ion chelating activity was evaluated by a standard method with minor changes [14]. The reaction was carried out in HEPES buffer (20 mM, pH 7.2) with various concentrations (0-120 μg/ml) of RTP extract, 12.5 μM of ferrous sulfate solution and ferrozine (75 μM). After incubation, the absorbance was measured at 562 nm. EDTA was used as a positive control.

Reducing Power Assay

The Fe^{3+}-reducing power of the extract was determined by the method of Oyaizu with a slight modification [15]. Different concentrations (0-1 mg/ml) of the extract (0.5 ml) were mixed with 0.5 ml phosphate buffer (0.2 M, pH 6.6) and 0.5 ml potassium hexacyanoferrate (0.1 %), followed by incubation at 50°C in a water bath and the addition of 0.5 ml of TCA (10%). The upper portion of the solution (1 ml) was mixed with 1 ml distilled water, and 0.1 ml $FeCl_3$ solution (0.01%) was added. The absorbance was measured after 10 min at 700 nm. Ascorbic acid was used as a positive control.

Lipid Peroxidation Inhibition Assay

This assay was carried out according to the standard method with slight modification [16]. Fresh brain homogenate was prepared from chicken, collected from the local market. A 100 μl aliquot of the supernatant homogenate was mixed with the RTP extract of various concentrations (0-25 μg/ml), followed by addition of 0.1 mM $FeSO_4$ and 0.1 mM ascorbic acid, and incubated for 1 h at 37°C. TCA was used to stop the reaction and then TBA was added followed by heating at 95°C for 30 min to generate the color. Finally, the samples were cooled on ice, centrifuged at 8000 rpm for 2 min and the absorbance of the supernatant was taken at 532 nm. Trolox was used as the standard.

Determination of Total Phenolic- and Flavonoid Content

Total phenolic content was determined using Folin-Ciocalteu (FC) reagent according to the standard method [17]. The phenolic content was evaluated from a gallic acid standard curve. The total flavonoid content was determined with aluninium chloride ($AlCl_3$) according to a previously described method using quercetin as a standard [18]. The flavonoid content was calculated from a quercetin equivalent standard curve.

Statistical Analysis

All data are given as the mean ± SD of three measurements. Statistical analyses were performed using KyPlot version 6.0 and XLSTAT Version 2016.02.28451. The IC_{50} values were calculated by the formula Y = 100*A1 / (X + A1), where A1 = IC_{50}, Y = response (Y = 100% when X = 0), X = inhibitory concentration. The IC_{50} values were compared by paired t tests. $p < 0.05$ was considered significant. Pearson correlation (r) test was carried out to identify the association between different parameters that exhibit the antioxidant and free radical scavenging properties Principal component analysis (PCA) was employed to identify the most important contributing parameters for the observed variance in the data set.

RESULTS AND DISCUSSION

DPPH Radical Scavenging Activity

Figure 1 (a) revealed a significant ($p<0.05$ and $p<0.01$) dose-dependent increase in the percentage of DPPH radical scavenging activity of RTP extract when compared to the standard α-tocopherol. The percentage of DPPH radical scavenging of RTP extract and the standard was 8.88% and 9.86%, respectively, at 50 g/mL, but at 200 µg/mL dose, the radical scavenging was enhanced to 21.08% and 23.55%, respectively. The IC_{50} values of RTP extract and standard were 694.81±9.1 µg/mL and 557.57±3.74 µg/mL on DPPH radical scavenging, respectively. This demonstrates that the RTP extract comprises active elements capable of donating hydrogen to a free radical in order to eliminate the odd electron that causes radical reactivity. The RTP extract's DPPH scavenging capacity indicates its antioxidant capability.

Total Antioxidant Activity

The total antioxidant activity of red thumb potato extract was determined using the phosphomolybdenum reduction assay technique. In this assay, the extract reduces the Mo (VI) ion to Mo(V), resulting in the formation of a blue phosphate/Mo (V) complex at an acidic pH. This assay determines the rate of reduction of antioxidant, oxidant, and molybdenum ligands in a quantitative manner. The total antioxidant value of the extract was 0.881±0.07 gram equivalent of ascorbic acid.

Hydroxyl Radical Scavenging Activity

The experiment indicates the ability of the extract and standard mannitol to block hydroxyl radical-mediated deoxyribose degradation in a Fe^{3+}-EDTA-ascorbic acid and H_2O_2 reaction combination. When RTP extract was introduced to the reaction mixture, it eliminated the hydroxyl radicals from the sugar, preventing the reaction from occurring. Figure 1(b) depicts the results. The extract and standard have IC_{50} values of 24.73±1.17 µg/ml and 578.07±5.65 µg/ml, respectively, in this assay. The extract had a higher IC_{50} value than the standard, with percentages of inhibition of 79.41% and 20.77% for RTP and mannitol, respectively, at 200 µg/ml.

Superoxide Radical Scavenging Activity

Superoxide radicals, formed via the PMS-NADH interaction, may be evaluated by their capacity to reduce NBT. The sharp decline in absorbance at 560 nm with the RTP extract and the standard quercetin reflects their ability to quench superoxide radicals in the reaction mixture. The RTP extract and quercetin showed IC_{50} values of 55.75±1.05 µg/ml and 22.68±0.58 µg/ml, respectively, on superoxide scavenging activity, as shown in Fig. 4. At 20 µg/ml, the percentage inhibition of superoxide radical by RTP extract was 20.04%, while quercetin inhibited 43.56%. Therefore, the RTP extract might be used to as a good alternative for the treatment of superoxide radical-mediated diseases such as ischemia.

Nitric Oxide Radical Scavenging Activity

As represented in Fig. 2(b), RTP extract inhibited moderate amount of nitric oxide in a dose- dependent manner, with an IC_{50} value of 279.84±11.73 µg/ml, whereas the IC_{50} value of curcumin was 100.81±0.68 µg/ml. The RTP extract and curcumin had a percentage of inhibition of 23.57% and 42.51% at 70 µg/ml, respectively. Nitric oxide is formed

when sodium nitroprusside combines with oxygen. RTP prevents the formation of nitrite by directly competing with oxygen in the nitric oxide process. Reduced nitric oxide production in the digestive system was shown to be beneficial in avoiding the formation of carcinogenic nitrosoamines and nitrosoamides from nitrates [19]. Therefore, the RTP extract's dose- dependent NO scavenging activity might protect against nitrosoamine-mediated carcinogenesis.

Hydrogen Peroxide Scavenging Activity

The FOX reagent was used to measure hydrogen peroxide scavenging activity. When compared to the standard sodium pyruvate (IC_{50} = 15.60±0.48 mg/ml), RTP extract has considerable H_2O_2 scavenging activity (IC_{50} = 22.71±0.66 mg/ml). The proportion of scavenging for RTP and sodium pyruvate at 2 mg/ml was 8.31% and 14.8%, respectively [Figure 3 (a)].

Hypochlorous Acid Scavenging Activity

HOCl seems to primarily target cysteine and methionine residues in proteins, as well as reduced glutathione (GSH), modifying protein structure and function and reduced the antioxidant status in the cell. Through the degradation of the heme prosthetic group, HOCl may inactivate the antioxidant enzyme catalase [20]. Figure 3(b) demonstrated that RTP extract exhibits an efficient hypochlorous acid scavenging activity (IC_{50} = 106.50±4.73 µg/ml) when compared to that of ascorbic acid (IC_{50} = 54.74±0.65 µg/ml). The RTP extract scavenged 38.5% of the HOCl, while ascorbic acid scavenged 49.07% at 100 µg/ml, indicating the HOCl scavenging capability of the RTP extract.

Iron Chelation Assay

In the presence of Fe^{2+}, ferrozine forms a violet complex, the formation of which is disrupted in the presence of a chelating agent, resulting in a reduction in the complex's violet hue. The formation of the ferrozine-Fe^{2+} complex was hindered in the presence of the test and reference compounds, as shown in Figure 4 (a). The RTP extract and EDTA showed IC_{50} values of 234.11±28.93 µg/ml and 24.91± 2.26 µg/ml, respectively. At 120 µg/ml, the percentage inhibition of the plant extract and EDTA was 43.01% and 70.46%, respectively.

Reducing Power Assay

The conversion of Fe^{3+} to Fe^{2+} in the presence of RTP extract and the reference compound (ascorbic acid), was used to assess the reductive capacity as shown in Figure 4 (b). At the highest dose, i.e., 1 mg/ml, the absorbance of the RTP extract and ascorbic acid was 0.121 and 0.131, respectively, indicating high reducing power capacity of the RTP extract, compared to the standard, ascorbic acid.

Lipid Peroxidation Inhibition Assay

The IC_{50} values of the sample (184.83±1.88 µg/ml) and the standard (6.71±0.24 µg/ml) indicated that the RTP extract has a low inhibitory efficiency when compared to standard trolox. The dose-dependent increase in lipid peroxidation inhibition activity of the RTP extract, as shown in Figure 5, demonstrates its antioxidant capability.

Determination of Total Phenolic- and total flavonoid Content

The methanolic extract of red thumb potato possessed 295.91±0.004 mg gallic acid equivalent phenolic content in 1 gm of dried plant extract, whereas 175.19±0.016 mg quercetin equivalent flavonoid was present in 1 gm of dried plant extract, indicating that red thumb potato extract includes a considerable quantity of flavonoids and phenolics compounds. Both of these chemicals have high antioxidant capacity and have significant impacts on human nutrition and health. Flavonoids function by scavenging or chelating the free radicals in the body, whereas phenolic compounds confer scavenging properties due to the presence of their hydroxyl groups.

Pearson's correlation analysis

A positive correlation was observed between the total phenolic content and DPPH radical scavenging ($r = 0.957^c$), superoxide radical scavenging ($r = 0.982^c$), nitric oxide radical scavenging ($r = 0.879^c$), and reducing power ($r = 0.945^c$), whereas, the total flavonoid content showed positive correlation with total antioxidant capacity ($r = 0.892^c$), and

hydroxyl radical scavenging (r = 0.912^c). Phenolic and flavonoid molecules are key antioxidant components that deactivate free radicals by donating hydrogen atoms to them. [21]. The strong correlations between total phenolic content and DPPH scavenging activity support the role of phenolic compounds as the primary contributor to RTP's antioxidant properties. Positive correlation was observed between total phenolic content and reducing power because the RTP extract may act as a good electron donor since phenolic compounds present in it. The presence of considerable amount of phenolic compounds in the RTP extract explains the positive correlation between hydroxyl radical scavenging and total flavonoid content in RTP [22].

Principal component analysis (PCA)

The Scree plot (not shown) indicated two principal components, having eigenvalues of 7.881 and 4.119 respectively. The first two principal components explained 100% in the data set, with the first components explaining 65.67% of the variance on its own. Eigenvalues of greater than 1.0 and component loadings of greater than 0.7 are considered to be significant. Figure 6 shows the correlations among the variables using a biplot. Strong positive loading (>0.70) was observed for DPPH (0.944), nitric oxide (0.858), superoxide radical (0.974), reducing power (0.931), and total phenolics (0.999) in the first principal component (F1), while significant negative loading was observed for total antioxidant (-0.857), hydroxyl radical (-0.833), and hydrogen peroxide (-0.898). In the second principal component (F2) iron chelation (0.810) and lipid peroxidation (0.890) showed considerable positive loading (>0.70), while hypochlorous acid (-0.793) and total flavonoids (-0.847) showed high negative loading. On the biplot, the angle between the total antioxidant capacity and hydroxyl scavenging activity is very small, indicating that two factors are positively correlated. PCA analysis of the present study showed that total phenolics, DPPH radical, superoxide radical, reducing power were the most prominent factors (or components) that can influence overall antioxidant, free radical scavenging activity of the red thumb potato.

CONCLUSION

Based on the findings of the present study, it can be stated that the methanolic extract of the red thumb potato contains significant quantities of flavonoids and phenolic compounds, shows strong antioxidant and free radical scavenging properties, and also possesses reducing power, iron chelating capacity, and the ability to suppress lipid peroxidation. These *in vitro* assays revealed the presence of various bioactive components and their potential synergistic effects that confirms the healthy role of this potato in human nutrition and, more importantly, highlight the importance of this particular potato variety in the development of functional foods aimed to prevent the chronic neurodegenerative disorders. Therefore, future research should be directed to isolate the bioactive components from this potato variety, as well to conduct different *in vivo* experiments prior to its therapeutic applications.

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The authors thank Indrajit Das (Local farmer) providing us the red thumb potato sample.

CONFLICT OF INTEREST

The authors declare no competing interests.

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Table 1: Scavenging of reactive oxygen species, iron chelating activity and lipid peroxidation inhibition (IC_{50} values) of Red thumb potato and reference compounds.

Activity	Extract/Reference	IC_{50}(#)
DPPH	Redthumbpotato α-tocopherol	694.81±15.77 557.57±6.49(3)**
Hydroxylradical($OH^{\cdot}$)scavenging	Redthumbpotato Mannitol	24.73±1.17 578.07±5.65(3)***
Super oxideanion ($O_2^{\cdot-}$)scavenging	Redthumbpotato	55.75±1.05

	Quercetin	22.68±0.58(3)***
Nitricoxideradical(NO)scavenging	Redthumbpotato Curcumin	279.84±11.73 100.81±0.68(3)**
Hydrogenperoxide (H_2O_2)scavenging	Redthumbpotato Sodiumpyruvate	22.71±0.66 15.60±0.48(3)**
Hypochlorous acid (HOCl) scavenging	Redthumbpotato Ascorbic acid	106.50±4.73 54.74±0.65(3)**
Iron chelating	Redthumbpotato EDTA	234.11±28.93 23.41±0.74(3)**
Lipid peroxidation inhibition	Redthumbpotato Trolox	184.83±1.88 6.71±0.24(3)***

Units of IC_{50} for all activities are µg/ml, except H_2O_2 scavenging, where the units are mg/ml. Data are expressed as mean ± S.D. Data in parenthesis indicate number of independent assays.
EDTA- Ethylenediamine tetra acetic acid. *p < 0.05; ***p < 0.001 vs Red thumb potato.

Table – 2: Pearson's correlation matrix of different parameters that exhibit the antioxidant and free radical scavenging properties

	DPPH	Total Antioxidant	Hydroxyl Radical	Superoxide Radical	Nitric Oxide Radical	Hydrogen peroxide	Hypochlorous Acid	Iron Chelation	Reducing Power	Lipid peroxidation inhibition	Total Phenolics	Total Flavonoids
DPPH	1											
Total Antioxidant	-0.639[a]	1										
Hydroxyl Radical	-0.603[a]	0.999[c]	1									
Superoxide Radical	0.994[c]	-0.717[b]	-0.684[a]	1								
Nitric Oxide Radical	0.980[c]	-0.471	-0.430	0.953[c]	1							
Hydrogenperoxide	-0.993[c]	0.543	0.504	-0.975[c]	-0.997[c]	1						
Hypochlorous Acid	0.837[c]	-0.114	-0.069	0.774[b]	0.930[c]	-0.896[c]	1					
Iron Chelation	0.286	-0.920[c]	-0.937[c]	0.386	0.088	-0.171	-0.284	1				
Reducing Power	0.999[c]	-0.610[a]	-0.572	0.990[c]	0.987[c]	-0.997[c]	0.857[c]	0.250	1			
Lipid per oxidation inhibition	0.136	-0.849[c]	-0.872[c]	0.241	-0.066	-0.018	-0.428	0.988[c]	0.099	1		
Total Phenolics	0.957[c]	-0.835[c]	-0.809[b]	0.982[c]	0.879[c]	-0.915[c]	0.642[a]	0.553	0.945[c]	0.419	1	
Total Flavonoids	-0.222	0.892[c]	0.912[c]	-0.325	-0.022	0.105	0.347	-0.998[c]	-0.185	-0.996[c]	-0.497	1

[a]p <0.05,[b]p<0.01and[c]p<0.001

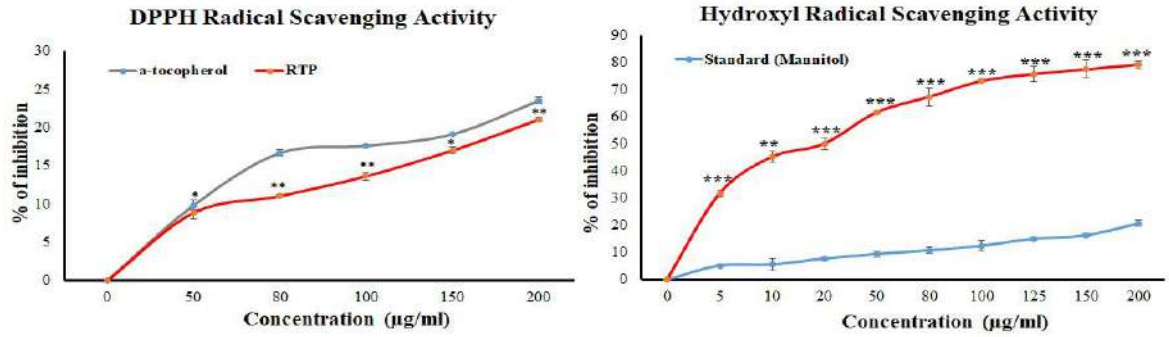

Figure 1(a): DPPH radical scavenging activity of the red thumb potato extract. Data represent the effect of RTP extract and α-tocopherol on the scavenging of DPPH radical. Figure 1(b): and the reference compound mannitol.

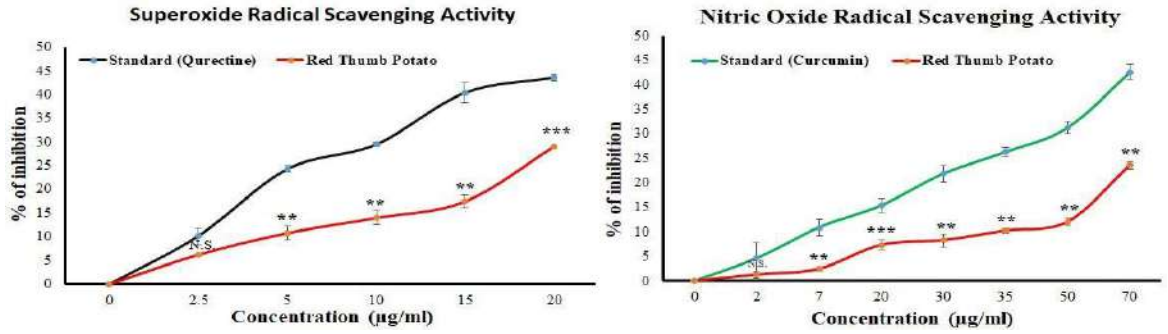

Figure 2 (a): Superoxide radical scavenging assay. Scavenging effect of red thumb potato extract and the standard quercetin on superoxide radical. Figure 2 (b): The nitric oxide radical scavenging activity of RTP extract and the standard curcumin.

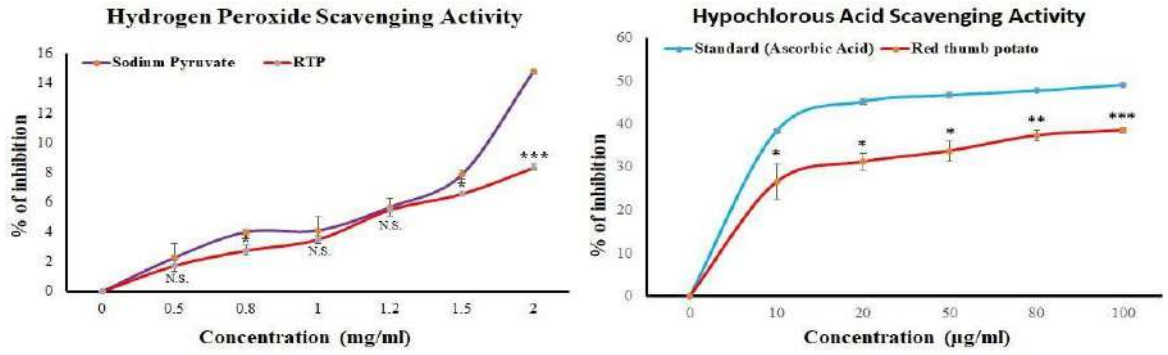

Figure 3 (a): Hydrogen peroxide scavenging assay. Effect of RTP extract and the sodium pyruvate on the scavenging of H_2O_2. Figure 3 (b): Hypochlorous acid scavenging activities of RTP extract and the standard ascorbic acid.

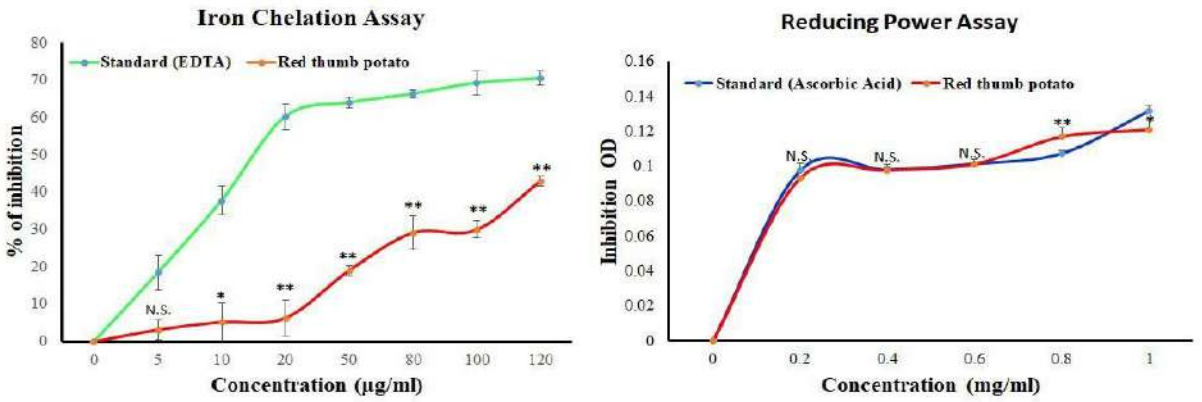

Figure 4 (a): Iron chelation assay of RTP. Effects of RTP extract and standard EDTA on Fe^{2+}- ferrozine complex formation is shown. Figure 4 (b): Reducing power assay. The reductive abilities of RTP extract and the standard ascorbic acid is shown.

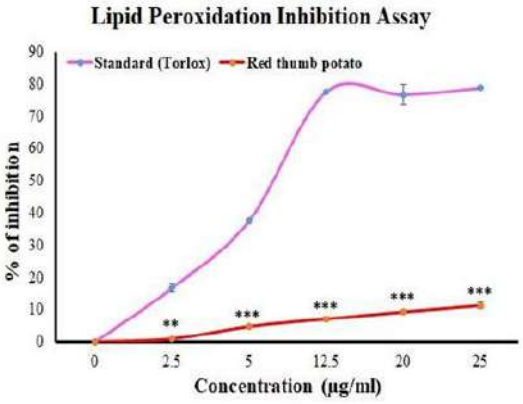

Figure 5 Inhibition of lipid per oxidation by RTP extract and the standard trolox.

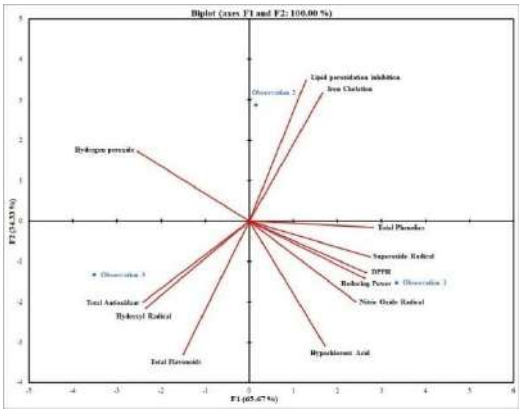

Figure 6- Biplot of Principal component analysis of the antioxidant, different free radical scavenger, and phytochemicals in red thumb extract.

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RESEARCH ARTICLE

MIL-STD-105D with Single Double Sampling Plan

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ABSTRACT

This research paper is analyzing the MIL-STD-IO5D with normal plan as single sampling plan and tightened plan as double sampling plan using quick switching system. Tables are provided for determining system and identified similarities between QSSDSS-3 and 105D-SDSS OC curves. The system is matched with existing system and efficiency values are calculated. Tables are constructed and presented with suitable examples.

Keywords: Double sampling plan, MIL-STD-105D, Operating Characteristic curve, Quick switching system, and Single sampling plan.

INTRODUCTION

Acceptance sampling techniques developed during the Second World War. Harold F. Dodge has developed Sampling plans, such as MIL-STD-105. It was an U.S. military specification that established rules and tables for sampling by attributes established Walter A. Shewhart, Harry Romig, and Harold Dodge's sample inspection ideas and mathematical formulas. MIL-STD-105 A, B, C, D, and E were created as a result of additional developments throughout the years. MIL-STD-105D is a version of MIL-STD-105 that has been upgraded. The U.s approved it in 1963. The ANSI accepted it as ANSI Standard Z1 in 1971. The Military Standard 105D sample plan is essentially a collection of separate plans that are arranged into a sampling scheme system. A sampling system consists of a standard sampling plan, a tighter sampling plan, and a reduced sampling plan, as well as switching instructions. It is anticipated that the producer and the consumer would agree on the AQL for a certain product attribute when employing the MIL-STD-105D. Both can agree that the Producers will submit a number of lots for inspection that are typically as good as the consumer's criteria. Acceptance or rejection of lots based on a sampling plan, as well as the ability to switch to a new, more stringent sampling plan if there is proof that the Producer's product does not meet

the agreed-upon AQL, guarantees that quality is maintained. MIL-STD-105D switching, as well as single, double, multiple, chain, and variable sampling schemes, are compared to Quick Switching Systems. This paper introduces a new system which incorporates two reference plan namely normal SSP with parameters (n, c) and tightened DSP with parameters (n; c_1, c_2) where $n=n_1=n_2$ switching procedures of MIL-STD-105D (1963). The system is known as MIL-STD-105D Single Double Sampling System (105D SDSS). It is designated as 105D-SDSS (n; c; c_1, c_2), where $n=n_1=n_2$, c_1 = 0 or 1, $c_2 > c$, c_1, values are restricted to 0 and 1, to develop more manufacture purpose. Tables are provided for identifying the system and comparing the OC curves of the QSSDSS-3 and the 105D-SDSS systems. QSSDSS-3 and 105D SDSS-3 were compatible with the system. The efficiency figures are computed. QSSDSS-3 values are taken from vennila and devaraj arumainayagam (2018).

MEASURES OF PERFORMANCE

OC Function

The 105D-SDSS (n; c, c_1, c_2) O.C. function (Romboski (1969)) is shown below

$$P_a(p) = \frac{P_N P_T^{\,5}(2-P_N^{\,4})(1-P_T) + P_T(1-P_N)(1-P_T^{\,4})(2-P_N^{\,5})}{P_T^{\,5}(2-P_N)^4(1-P_T) - (1-P_N)(1-P_T^{\,4})(1-P_N^{\,5})} \quad (1)$$

When utilizing a standard single sample strategy, P_N = Proportion of lots expected to be accepted (n; c) When utilizing a stricter double sampling strategy, P_T = Proportion of lots predicted to be accepted (n; c_1, c_2) The values of PN and PT are provided by under the assumption of the Poisson Model (Hamaker and Van Strik (1995)).

$$P_N = \sum_{x=0}^{c} e^{-np}(np)^x / x!$$

$$P_T = \left(\sum_{x=0}^{c_1} e^{-(np)}(np)^x / x! + \left(\sum_{x=c_1+1}^{c_2} e^{-(np)}(np)^x / x! \sum_{x=0}^{c_2-(c_1+1)} e^{-(np)}(np)^x / x! \right) \right) \quad (2)$$

Application Requirements

1. Manufacturing is constant enough that the findings of current and past lots are broadly suggestive of a continuous process, and submitted lots are presumed to be of comparable quality.
2. Lots are submitted in about the same sequence as they were produced.
3. Quality is defined as fraction nonconforming, and inspection is done by characteristics.

Procedure to Follow

Step 1: Use a single sample plan with parameters n and c to check under normal. Go to step 2 if three out of five lots are rejected in a row; otherwise, go back to step 1.

Step 2: Use a double sample plan with parameters n, c_1, and c_2 to investigate under more stringent conditions. Return to step 1 if five lots in a row are approved; otherwise, repeat step 2.

Properties of OC curve

The matched OC curves of QSSDSS-3 and 105D-SDSS were shown in Figures 1 and 2. Thus, by using the QSSDSS-3 simple switching rules, all of the benefits of MIL-STD-105D (1963) normal and tighter switching rules may be obtained.

DESIGNING SYSTEM

In this paper, table is constructed to design 105D-SDSS (n; c; c_1; c_2). The procedures are used to design the systems. The systems are explained below with an example.

System Design p1, p2, α and β

Table 3 may be used to design 105D-SDSS for given values of p_1, p_2, α and β by following the procedures below:

(i) Calculate operating ratio p_2 / p_1

(ii) In Table 3, identify the operating ratio value that is closest to the needed in the relevant column.

(iii) Match the values of c, c_1, c_2 and np_1 to the proportion;

(iv) The system's sample size is calculated by means of division np_1 by p_1.

Example

Get 105D-SDSS (n; c; c_1, c_2) for the provided values of p_1=0.01, α =0.05, p_2=0.015, and β =0.10 for the specified values of p_1=0.01, α =0.05, p_2=0.015, and β =0.10

(i) p2/p1 = 0.015 / 0.01 = 1.5 is the result

(ii) The value of p2/p1 in the =0.05 and =0.10 column of Table 3 is 1.5076, which is nearly equivalent to 1.5.

(iii) c=6, c_1=0, c_2=2 and np_1=2.1224 are the values of c, c_1, c_2 and np_1 that equate to 1.5076.

(iv) The sample size is calculated using the following formula n= np_1 / p_1 = 2.1224/0.01=212;

(v) The designed system is 105D-SDSS (212; 6; 0, 2).

Construction of Table

The 105D-SDSS (n; c, c_1, c_2) O.C. function (Romboski (1969)) is shown below

$$P_a(p) = \frac{P_N P_T^{\,5}(2-P_N^{\,4})(1-P_T) + P_T(1-P_N)(1-P_T^{\,4})(2-P_N^{\,5})}{P_T^{\,5}(2-P_N)^4(1-P_T) - (1-P_N)(1-P_T^{\,4})(1-P_N^{\,5})} \quad (1)$$

where P_N and P_T are given in (2).

For provided values of c, c_1, c_2, and Pa(p), In the case of np, equation (1) is solved with MATLAB application using the unity value technique. Table 3 lists such np_1 and np_2 values for various c, c_1, c_2, and Pa(p). The ratio p_2/p_1 is computed using these values for a hypothetical values of α = 0.05 and β = 0.10, and the results are reported in Table 3.

COMPARISON & CONCLUSION

1. The matching probability of acceptance values for the QSSDSS-3 and 105D-SDSS systems are shown in Table 1 under the premise that both systems utilise the same normal SSP and tighter DSP. Vennila and Arumarinayagam provided the QSSDSS-3 values (2018). The resemblance between the OC curves of the QSSDSS-3 and 105D-SDSS systems in the relevant region may be found in this table.

2. Table 2 gives 12 sets of matched QSSDSS-3 and 105D SDSS. The values of QSSDSS-3 are taken from Vennila and Arumarinayagam (2018). The matching is based on the operating ratio. Efficiency values are calculated by dividing the $np_{0.95}$ of 105D-SDSS by QSSDSS-3 and it reveals that in most of the systems, 105D-SDSS requires lesser sample size than that of the 105D-SDSS to achieve the equivalent performance.

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Table 1: Points of the OC curve for the QSSDSS-3 and 105D-SDSS systems

p	Probability of acceptance for			
	n=50, c=2, c_1=1, c_2=3		n=100, c=3, c_1=0, c_2=2	
	105D SDSS	QSSDSS-3	105D SDSS	QSSDSS-3
0.010	0.9856	0.9859	0.9779	0.9627
0.015	0.9596	0.9600	0.8013	0.7719
0.020	0.9193	0.9189	0.3928	0.4428
0.025	0.8636	0.8616	0.2167	0.2318
0.030	0.7903	0.7884	0.1242	0.1266
0.035	0.7013	0.7028	0.0670	0.0700
0.040	0.6049	0.6107	0.0385	0.0385
0.045	0.5114	0.5192	0.0210	0.0210
0.050	0.4266	0.4338	0.0115	0.0115
0.055	0.3526	0.3578	0.0063	0.0063
0.060	0.2891	0.2923	0.0035	0.0035
0.065	0.2353	0.2372	0.0019	0.0019
0.070	0.1904	0.1914	0.0011	0.0011

Table 2: 105D-SDSS and its matched QSSDSS-3 (n; c; c_1, c_2)

S.No	105D System					QSSDSS-3 (n; c; c_1, c_2)					E_1*
	c	c_1	c_2	OR	$np_{0.95}$	c	c_1	c_2	OR	$np_{0.95}$	
1	4	0	3	2.3428	1.7721	5	1	2	2.3048	1.7189	1.0310
2	5	0	4	2.1685	2.4023	5	0	3	2.1419	1.9484	1.2330
3	5	1	4	2.0997	2.3295	6	0	4	2.0216	2.5871	0.9004
4	4	0	2	2.0746	1.5378	5	0	2	1.9856	1.6311	0.9428
5	6	0	4	1.8424	2.8277	8	1	6	1.8076	3.7715	0.7498
6	5	0	2	1.7326	1.8423	6	0	1	1.7267	1.5609	1.1803
7	8	1	7	1.6463	4.7783	9	1	6	1.6593	4.1210	1.1595
8	5	0	1	1.6319	1.5331	8	0	4	1.6374	3.2261	0.4752
9	9	0	6	1.5820	4.6738	7	0	2	1.5815	2.1333	2.1909
10	10	0	7	1.5619	5.4336	9	1	5	1.5692	3.7422	1.4520
11	8	0	4	1.4750	3.5344	9	0	3	1.4399	3.0601	1.1550
12	10	0	5	1.3646	4.6218	10	0	3	1.3705	3.3092	1.3967

Table 3: Values of np_1, np_2 and OR for given 105D SDSS

c	c_1	c_2	$np_{0.95}$	$np_{0.10}$	OR
2	0	1	0.6843	2.4904	3.6394
3	1	2	1.2203	3.9280	3.2188
3	0	2	1.1915	3.1899	2.6772
3	0	1	0.9905	2.4908	2.5146
4	1	2	1.6029	3.9282	2.4507
4	1	3	1.7439	4.2301	2.4257
4	0	3	1.7721	4.1516	2.3428
4	0	2	1.5378	3.1904	2.0746
5	1	3	2.1226	4.2305	1.9931
4	0	1	1.2691	2.4925	1.9640
5	0	3	2.1598	4.1520	1.9224
6	0	4	2.8277	5.2098	1.8424
6	1	4	2.7211	4.8918	1.7977
7	0	5	3.5261	6.2987	1.7863
5	0	2	1.8423	3.1920	1.7326
6	1	3	2.4595	4.2317	1.7205
9	0	7	4.9829	8.4861	1.7031
6	0	3	2.4982	4.1531	1.6624
8	1	7	4.7783	7.8663	1.6463
5	0	1	1.5331	2.5018	1.6319
7	0	4	3.1991	5.2106	1.6288
7	1	4	3.0681	4.8932	1.5949
9	0	6	4.6738	7.3940	1.5820
10	0	7	5.4336	8.4866	1.5619
7	1	2	2.5785	3.9403	1.5282
6	0	2	2.1224	3.1997	1.5076
7	0	3	2.8056	4.1576	1.4819
8	0	4	3.5344	5.2133	1.4750
9	0	5	4.2884	6.3011	1.4693
8	1	4	3.3866	4.8980	1.4463
6	0	1	1.7894	2.5503	1.4252
8	1	2	2.8779	3.9797	1.3829
10	0	5	4.6218	6.3068	1.3646
7	0	2	2.3876	3.2365	1.3555
7	0	1	2.0418	2.6790	1.3121
9	1	2	3.1714	4.0900	1.2897
8	0	2	2.6433	3.3406	1.2638
8	0	1	2.2921	2.8659	1.2503
10	1	2	3.4607	4.2706	1.2340
9	0	1	2.5415	3.0803	1.2120
10	0	3	3.6307	4.3754	1.2051
10	0	2	3.1367	3.6974	1.1788

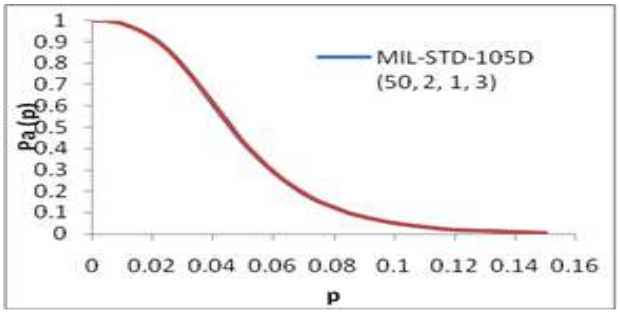

Figure 1: O.C. curves of QSSDSS-3 (n; c; c_1, c_2) and 105D SDSS

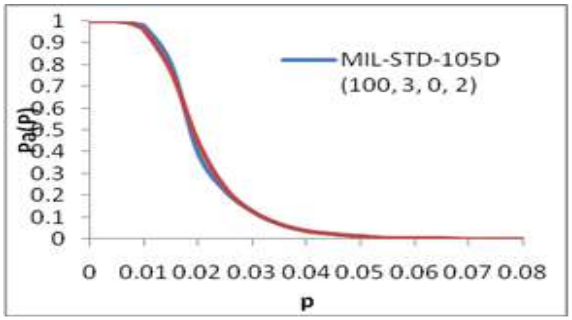

Figure 2: O.C. curves of QSSDSS-3 (n; c; c_1, c_2) and 105D SDSS

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RESEARCH ARTICLE

A Comparative Study on Secure Data Sharing in Cloud Environment

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ABSTRACT

Cloud is a vast platform that fundamentally offers many services over the internet on a pay-as-you-go basis, where one among them is cloud storage. It affords a cost-efficient solution for resource sharing between the cloud users. Owing to huge popularity on cloud computing, numerous organizations employ the public cloud to share the data in a secure manner and to store the data on large-scale. Providing secure dynamic cloud data sharing scheme without effecting the user revocation process is not an easy task. Nevertheless, the cloud is vulnerable to many privacy and security attacks. Resolving security issues in the public cloud have attracted more attention in recent research. The survey of secure cloud data sharing has become significantly essential with the developments and rising requirement in the public cloud data sharing. This survey reviews different data sharing and cryptographic methods in cloud and also illustrates a thorough review of security concerns.

Keywords: Cloud Computing, Cloud Security, Cloud Services, Cloud Storage, Cryptography, Data Privacy, Public Cloud, Resource Sharing, Secure Data Sharing, Data Security

INTRODUCTION

Cloud computing is growing rapidly to empower data sharing capabilities and offering numerous benefits to the customer. For enterprises, the elasticity can be encountered along with the standard security features [1] [2]. In cloud, many tenants as well as individual customers can store their data in a flexible manner. It has several advantages such

as prevention of capital expenditure, software, hardware, and relief of online data storage burden. Data sharing [3] [4] is being a critical requirement for numerous users, businesses, and organizations those directing to gain profit. As data sharing has become significantly social, it has been greeted by enormous number of people in recent times. More and more people are demanding the capability of data sharing on their mobiles, PCs, and even recently smart televisions. Now-a-days, people adore to share the information with either friends, family, or social group. Benefits of data sharing are:

- Greater productivity: Companies, hospitals, and students are getting benefits by collaborating with each other over lower cost and better efficiency.
- More delight: Numerous people of any gender, age, or society are sharing their experience in life via social networking sites such as Facebook or MySpace with friends, family and colleagues.

Two main challenges in cloud computing are the security and reliability [5]. The cloud data of the user may be retrieved by any unauthorized users, thus arising security issues [5] [6] [7] on user's data. Many methodologies are available for enhancing the security of data in the cloud. Some of these are (a) encryption process that employs complex step for hiding the information with the help of key, (b) authentication process, which access the data by creating a user name and password, and (c) authorization process that access the cloud data by offering the permission to the users. The users are susceptible to store the data on a remote server/physical machine due to several security issues. In order to limit these kind of risks, many cloud companies spend a huge amount of money in security measures.

The main requirement for cloud data sharing is that only the authorized customer can be able to get admittance for accessing the data in the cloud. Some secure data sharing requirements [6] [3] are:

- Data security, where the cloud provider must protect the information (i.e. data and applications) of the customer.
- Data privacy, where the cloud provider provides access only to the authorized users and should protect the credentials and digital signatures of the customer.
- Data confidentiality, where the data stored in the cloud protects against unintended users. Only the authorized parties can access the data.
- Fine-grained access control, where the cloud provider grants access to a group of customers and allows flexibility.
- Data integrity, where the unauthorized customers should not delete, manipulate, or fabricate the data.
- Data auditing, where the verifier can audit the shared data integrity without regaining the whole data from the cloud.
- Beach prevention, a potential threat in the cloud due to multi-tenancy environment. It may occur internally (data manager) or externally (malicious attackers) to the data.

Strong cryptographic mechanisms are developed to address the data security issues. A hybrid cryptographic technique helps in addressing the data and key management issues for data owner. The challenges on security [8] in the cloud environment such as cloud deployment model, cloud service model, and other challenges on the network are depicted in the Table I. The rest of this article is systematized as follows. Section 2 briefly summarizes various data sharing techniques in the cloud computing environment. Section 3 describes the cryptographic methodologies in the cloud. Section 4 presents discussion on several techniques that employed for secure data sharing schemes.

Various Data Sharing Techniques In Cloud Computing Environment

Conventionally, the data owner stores the data on the trusted server that is well-organized by a fully trusted administrator. But, in the cloud, the conventional security storage methods cannot be directly applied as it is sustained and handled by a semi-trusted third party. Secure sharing of data is being the major issue in the public cloud and thus, various techniques are utilized to support the secure data sharing [9]. Accordingly, this section briefly discusses some of the popular data sharing schemes.

Integrity Checking Scheme for Data Sharing

Cryptanalysis scheme [10] reviewed the integrity verification for data sharing with multi-user modification in the cloud [11]. The security flaws pointed out by the cryptanalysis scheme are: an adversary modifies the shared data

and deceives the TPA by altering the proof information or by overwriting the data. The solution comprises the following seven algorithms [10] [11]:

- KeyGen: Master user in the group selects K (number of users) random number and then computes the system's public keys, system's master keys, and the user's secret keys.
- Setup: The master user splits the data files into data blocks and then splits every block into elements. The master user also uploads the data blocks and its authentication tags to the cloud server and then sends to the Third Party Auditor (TPA).
- Update: Once the group user modifies a data block, then the modified data block and its tag are uploaded to the cloud server and then sends to the TPA.
- Challenge: The TPA generates the challenging message (CM) and send it to the cloud server for verifying the data integrity.
- Prove: The cloud server responds the TPA with the proof information after receiving the CM.
- Verify: The TPA verifies the proof.
- User Revocation: If the user revokes from the group, all authentication tags made by revoked users are updated and secret keys are detached.

Better solution is suggested for the two security flaws without sacrificing any required features of the original scheme. But, the construction of secure communication channels among each pair of entities is more expensive.

SDS and Query Processing Framework

An efficient Secure Data Sharing (SDS) method [12] is proposed to accomplish fine-grained share over the outsourced cloud data using homomorphic encryption and proxy re-encryption. In this method, only the authorized user (those decided by the data owner) can access a set of attributes in the data record on an on-demand basis from the cloud. SDS framework consists of following feature: efficient revocation of the user, secure re-join of a formerly revoked user, collusion prevention among the user and the cloud service provider, collusion prevention among a revoked user and an authorized user, and support for secure processing of queries. Initially, in this framework, the data owner generates the key and distributes them to the cloud and the authorized users. Subsequently, the proxy re-encryption key is produced for distributing the encrypted data in a re-encrypted form. During the stage of data outsourcing, the data owner encrypts each data record and generates the authorization tokens. Along with the resultant authorization tokens, the encrypted data records are then directed to the cloud. The third stage is, the framework verifies whether the cloud customer is authorized to access any of the data records from the cloud. In the stage of user revocation, this framework does not leak any meaningful information to the cloud. Also, the collusion can be avoided (i.e. user-to-user collusion resistant) without revealing valuable information using SDS framework. The user-rejoin stage grant access to the rejoining of the cloud customer based on the new access privileges given by the data owner. Though, the framework is built on the top of the cloud infrastructure, it does not affect the access control policies, storage server's geographic location, and data replication. Further, it can be enhanced to accomplish better accuracy towards the concept of secure key sharing.

A Secure Anti-Collusion Data Sharing Scheme

In this scheme [13], a secure way of data sharing is proposed to achieve secure distribution of the key and data sharing among dynamic groups. Here, the group manager manages the process such as creation of parameters, registration of the user, and the revocation of the user. The group manager also acts as the leader of the group and thereby, it is fully trusted by the third parties. The group members (i.e. registered users) can store the data into the cloud and distribute them with others. Due to the new joined user or revoked user, the membership of the group may change dynamically. This method offers better efficiency, data confidentiality, and access control. It can be further extended by adding verification process to enhance the data integrity.

Secure Data Sharing Scheme among Group

SeDaSc methodology [14, 15] is designed to share and forward the data among a group without the process of re-encryption in the cloud computing environment. The entities involved in this method are the cloud, the Cryptographic Server (CS), and the user. A single cryptographic key is maintained for each of the data files. The

entire key is not placed and owned by any of the involved parties after encryption or decryption process. The key is partitioned into two constituent parts and owned by various entities. In order to achieve the security goals of this method, various cryptographic key operations are presented as follows:

- File upload: CS performs encryption and key management on behalf of the user. Also, the CS may be delegated the access privilege for uploading the file directly to the user.
- File download: After getting the user key share and the encrypted file from the cloud, the CS key share is then retrieved from the ACL. The file gets downloaded to the user once the CS key share exists in the ACL.
- File update: It is similar to the uploading process except the activities of the Access Control List (ACL) creation and the key generation.
- Inclusion of new group user: Based on the file owner request, the new user is added to ensure the backward access control.
- Group user departure: Forward control access is ensured by removing all the records and the ACL via the CS.
- Even though, this method guarantees the data confidentiality on the cloud using symmetric encryption, but it fails to provide the trust level in the CS.

Secure Sensitive Data Sharing

A systematic framework [16] is introduced to securely share the sensitive data on the platform of semi-trusted big data by encrypting the data before data submission. This framework ensures secure storage and submission of sensitive data using Heterogeneous Proxy Re-Encryption (H-PRE). H-PRE includes three kinds of algorithm: (1) Identity Based Encryption (IBE), (2) Re-encryption, and (3) Public key cryptosystem. At first, the data owner encrypts the sensitive data via a local security plug-in and then the encrypted data are uploaded to a big data platform. After PRE services, the transformed cipher text can be decrypted by a particular user. The decrypted clear text may contain user's private information. In order to preserve privacy, the user protection process technology based on a Virtual Machine Monitor (VMM) is adopted. It guarantees the user protection process via:

- Trusted VMM layer
- Bypassing guest OS
- Offering protection of data directly to the user process

The key management module dynamically decrypts the symmetric key and further stored it into the VMM memory. Successively, a lease-based technique is designed to accomplish high security by destroying the private data and keys thoroughly in a precise manner. Once the lease expires, the clear-text and keys occur nowhere in the cloud. This framework well protects the user's sensitive data and also balance the benefits of involved parties in the semi-trusted conditions as the data owners have the entire control of their own data. Further, this framework can optimize the H-PRE algorithm and enhance the encryption efficiency. Additionally, the overhead can be minimized for interaction among involved parties.

KAC for Scalable Data Sharing

Key-Aggregate Cryptosystem (KAC) [17] is designed to support the flexible delegation for scalable data sharing. That is, any subset of the encrypted cipher-text is decryptable by a constant size decryption key. A message is encrypted by the user under a public-key as well as a ciphertext identifier (i.e. class). Further, the cipher-texts are categorized into various classes in the cloud storage. In order to extract the secret keys for those classes, the key owner holds a master secret key. Subsequently, the aggregate key can be used to decrypt any subset of the ciphertext classes. The major advantage of this scheme is that the sizes of cipher-text, master secret key, and aggregate key are all of constant size. Also, the class does not need pre-defined hierarchical relationship. As the number of ciphertexts grows rapidly, enough cipher-text classes should be reserved for the future extension.

O-ACE for Cloud based Data Sharing Systems

Oblivious Access Control Evaluation (O-ACE) [18] procedure, is a novel access control mechanism, presented for cloud-based data sharing system. This security service influences the data owner to integrate O-ACE capabilities with the existing data sharing and collaborative services. Without studying the access control policy, the CSP can grant/deny access to outsourced resources using O-ACE. The authorized user can derive the valid decryption key by

learning the secret values. Whereas, an unauthorized user can only get some random numbers. The major contributions of O-ACE over cloud storage are:

- Provides end-to-end privacy for untrusted cloud server using standard cryptographic primitives.
- Data owner can choose any method for the target user's based on security requirements and computational capabilities.
- Offers better CPU usage cost.

Storing Shared Data via SEM

This approach [19] assures the cloud data integrity without revealing the anonymity of data owner using Semantic Mediator (SEM). The approach consists of seven algorithms: (1) Setup, (2) Blind, (3) Sign, (4) Unblind, (5) Challenge, (6) Response, and (7) Verify. In Setup, the public keys, the private keys, and the global parameters are produced. After performing Blind, Sign, and Unblind algorithms, a data owner can able to produce the verification metadata (i.e. signatures) by using SEM. A public verifier can challenge and verify the cloud data integrity by the cloud server interaction in Challenge, Response, and Verify. The properties achieved by this approach are:

- Efficiency over verification
- Efficiency over signing
- Public verifiability
- Unforgeability
- Data privacy
- Anonymity

This solution can reduce the mediator's requirements of computation and bandwidth. Further, it can be extended with multi-SEM model to enhance the trust level and to avoid single point of failure.

KASE for Group Data Sharing

Key-Aggregate Searchable Encryption (KASE) [20] scheme is addressed to apply on any cloud storage, which supports the searchable functionality of group data sharing. To support the KASE scheme, there are two main requirements for efficient key management.

- For sharing a number of files, a data owner only requires to share a single aggregate key instead of group of keys to a user.
- For executing a keyword search towards any number of shared files, the user only requires to submit a single aggregate trapdoor instead of a group of trapdoors to the cloud.

At first, a general KASE framework [20] is defined with seven polynomial algorithms, namely, setup for security parameter, generation of key, encryption process, and extraction of key, generation of trapdoor, adjustment, and testing of trapdoor. Subsequently, both functional (i.e. compactness, search ability, and delegation) and security (i.e. query privacy and controlled searching) requirements are described to design a valid KASE scheme. Then, it instantiates by framing a concrete KASE scheme. KASE scheme results in better efficiency and execution time, but it cannot be applied in the case of federated clouds.

Collaborative and Secure Sharing of Healthcare Data

In multi-cloud environment, a secure and privacy-preserving medical big data sharing architecture [21] is introduced to share the data among various cooperating organizations. Herein, the data cloud providers are semi-trustworthy (i.e., offers security against external adversaries, but unusual with regard to the data they store). In cooperating health centers, the medical records are generated, handled, and accessed by the authorized users. For protecting the data from curious data center, a secret sharing method is adopted. Multi-cloud proxies is utilized for sharing and retrieving the encrypted medical records simultaneously to and from the multiple data clouds. This method offers better availability of medical records and also supports selective data sharing between several groups of users. Furthermore, the system may address the aspects of key and policy management for the multi-cloud proxies.

CRYPT-BASED ENCRYPTION PROCEDURES IN CLOUD

Generally, once user needs to store the data in a secure manner on an untrusted storage, he/she must encrypt the data and then store the keys securely on the key store. Several encryption and key management techniques are applicable in the cloud computing environment. This section briefly overviews various cryptographic methodologies, which can be employed for secure data sharing in the cloud. Security methods are employed for providing the services of confidentiality, integrity, and authentication. Traditional cryptographic methods come under any of the two types: symmetric key or asymmetric key method. The former method provides fine-grained access control to the data, but it has several problems in handling key uniqueness. Also, it acquires maximum cost for key management. The latter method is a public-key based system in which the standard Public Key Cryptosystem (PKC) necessities a trusted certificate authority for issuing digital certificates. Nevertheless, this certificate management is too complex and costly.

Identity-based Encryption (IBE)

In order to address the issue of certificate management, a novel IBE technique [22] is introduced. It aids in public key encryption and managing certificate for Public Key Infrastructure (PKI) by creating an identity string. Practically, it is accomplished via the use of pairings (i.e., any identity string) instead of using public keys and certificates. In IBE, the Private Key Generator (PKG) holds a private key and produces a secret key for each and every user with an appropriate identity. One of the major limitation of IBE is high computation overhead at PKG. Tseng et al. [23] employ a new technique of revocable IBE along with the Cloud Revocation Authority (CRA). The CRA performs the revocation procedure for enhancing the PKG load. Outsourcing computation method with additional authorities has been utilized in [23, 24], which attains constant efficiency over user's private key size. Although, the users need not interact with PKG during key update, this scheme necessitate greater communicational and computational costs. It also lacks scalability as it keeps a secret value for all users during time key updation. But, the revocable IBE scheme [23] embraces only a master time key for performing the time key updation by the CRA without affecting security. It significantly enhance the performances and is secure against adaptive-identity attacks. This system is unable to aid the user to re-gain decryptability, and is not capable to fit an immediate revocation environment.

Attribute-based Encryption (ABE)

Subsequently, the ABE mechanism [25-28] has been employed to encrypt the content of the data that are accessed via the ACL. Based on the Access Control Policy (ACP) for each user, a central authority will establish secret keys for the users to decrypt a cipher-text. The two main types of ABE are Key-Policy ABE (KP-ABE) and Ciphertext-Policy ABE (CP-ABE) [29]. In the former policy, the ACP comprises private key of the users and the attributes of the encrypted data. The ACP is normally described as an access tree with the internal and leaf nodes signifying as threshold gates and attributes respectively. The latter policy is the adverse of KP-ABE, where the ACP and the user's key consist of the data and the attributes respectively. Ying et al. [30] provides the scalable data encryption for the data owner by constructing more appropriate data-outsourcing method than KP-ABE. Initially, the plain text is encrypted without any change in access policy. Further, the cipher text is outsourced to the cloud server and retrieved by the data owner. With a novel policy, the ciphertext is decrypted and then the plaintext is re-encrypted. Finally, the new cipher text is outsourced to the cloud server [31]. Though, this mechanism offers flexibility for the user, but it also has the problem of revocation. Whenever a user dynamic varies, ABE technique fails to update the private key of the existing users [32, 33].

Fully Homomorphic Encryption (FHE)

Similar to traditional cryptography, homomorphic encryption [34] guarantees data privacy in several aspects along with the additional features over encrypted data. The main limitation of conventional encryption methods is that it has to be decoded first for manipulating the data. Whereas, homomorphic encryption can benefit in preserving the privacy of the data. FHE method [35, 36] uses small-size symmetric keys and performs secure multi-party computation over the encrypted data in the cloud. Herein, the owner of the data is authorized for data encryption and data masking along with the functionality of encrypt and lock respectively. The processing center consists of two divisions:

- Delegator division, has functionality of keyset generation.
- Mapping division, has functionality of lock.

This method improves the security of data without employing client's secret key. It is well-suited for several data-centric and specific applications in the multi-cloud environment. Henceforth, the efficiency and the time complexity may be enhanced.

Certificate-Less Public Key Cryptography (CL-PKC)

In PKC, two kinds of keys are generated: secret key and digital signature, which can minimize the problem of managing keys. Both the keys cannot be generated separately, but can be created by executing the Certificate-Less PKC (CL-PKC) [37, 38] technique. The integrity of the cloud data is audited by leveraging the CL signatures without handling certificates or key escrow problem. Traditional CL signature method does not fulfil the features of the integrity verification without retrieving the whole data. Wang et al. [39, 40] developed a homomorphic authenticable CL signature method along with the blockless verifiability. This method does not necessitate a public verifier for handling the certificates and the risks in security. It also efficiently audits the data correctness in the cloud without downloading the whole data by the public verifier. The Key Generation Center (KGC) creates a partial private key that can be hold by each user along with the user-chosen secret key. Therefore, it resolves the key escrow problem, assures the user's public key validity, generates a secret key easily, and also offers high data confidentiality in the cloud. These schemes are computationally expensive in comparison with standard operations of bilinear pairing.

Proxy Re-Encryption (PRE)

PRE resolves the user revocation problem by re-encryption operation [41]. While finding information leakage, this technique allows the data owner to delegate a third party for performing re-encryption. When a user 'A' revokes, the decryptable ciphertext with user A is re-encrypted by a semi-trusted proxy. So that, the user A cannot access the cipher text without revocation. Several variants of PRE has been employed for achieving higher flexibility on re-encryption. The authors of [42] uses time-based PRE scheme to predetermine the user's access control validity period and also satisfy the time accuracy. But, this scheme will fail to recover the data with malicious users.

DISCUSSION AND CONCLUSION

The cryptographic methodologies employed in secure cloud data sharing were discussed in this review. The encryption is recommended as a better solution for securing data in the cloud. The result of the study on secure data sharing techniques is shown in the Table II. By using encryption algorithms, the data is more secure in both the local system and the remote cloud. To increase the trustworthiness on data storage over cloud, this study also suggests that the customers can be recommended to validate the security features before uploading their data to the data center. Hash calculation may also be applied to each file to ensure the integrity of data. Data confidentiality and data integrity has been accomplished by using Advanced Encryption Standard (AES), Data Encryption Standard (DES), Rivest-Shamir-Adleman (RSA), Message Digest 5 (MD5), and Elliptic Curve Cryptography (ECC). AES is a symmetric key encryption, where each ciphers have a block size and the key size independently [43]. DES makes secret code by operating plaintext and returning ciphertext on similar block size. RSA is the public key cryptography comprising private (for decryption) and public (for encryption) key [44]. MD5 is the cryptographic hash function with hash value, whereas, the ECC has both finite fields and binary fields. From this study, it is revealed that a hybrid of these techniques can provide better results in terms of performance, speedup ratio, turnaround time, and more. Table II depicts the information about various data sharing techniques in the cloud computing. Moreover, the surveyed outcome evidently demonstrates that the incorporation of cryptographic algorithms is better in terms of accuracy, processing time, and execution time. A lightweight scheme for sharing data [45] in secure manner over cloud environment seems to the better performance than the existing schemes.

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Table 1: Security Challenges On Cloud Computing

Cloud Deployment Model (Private, Public, Hybrid)	Cloud Service Model (SaaS, PaaS, IaaS)	Other Challenges on the Network
Cloning and resource pooling	Data leakage problems	Browser security
Authentication and identity management	Malicious attacks	SQL injection and flood attacks
Unencrypted data	Backup and storage	Incomplete data deletion
Residual data	Service Hijacking	Locks-in
Shared multi-tenant environment	Virtual Machine (VM) hopping	XML signature element wrapping

Table 2: Information about Various Data Sharing Schemes In Cloud Computing

Techniques	Authors and Reference	Year	Performance	Tool	Quality Measurement
Public Auditing Based Data Sharing Schemes					
Public Auditing Scheme	Yang et al [46]	2015	This scheme uses blind signature method for protecting the data. It also accomplish the identity traceability by Identity-Block List (IBL).	Pairing-Based Cryptography (PBC) Library	1. Low computational overhead 2. Less storage overhead 3. Low communication overhead 4. Correctness 5. Auditing soundness
Public Integrity Auditing Scheme	Yuan and Yu [11]	2015	This design employs polynomial-based authentication tags to allow the aggregation tags of various data blocks.	JAVA PBC (JPBC) Library	1. Better communication cost 2. Low user verification time 3. Low block update cost 4. Enhance system scalability
Public Verifiability Scheme	Wang et al [47]	2015	This scheme offers enhanced security against collusion attacks based on a Merkle Hash Tree (MHT) structure and proxy re-signatures.	PBC Library	1. Reduced computation cost 2. Reduced communication cost 3. Longest verification time
Oruta: Privacy-Preserving Public Auditing Scheme	Wang et al [48]	2014	Oruta utilizes the ring signatures for verifying the shared data integrity by the Third Party Auditor (TPA).	GNU Multiple Precision-Arithmetic (GMP) library and PBC library	1. Minimize signature storage 2. Low communication cost 3. Better auditing time 4. Data privacy 5. Identity privacy
Panda: Public Auditing Scheme	Wang et al [49]	2013	Panda exploits the proxy re-signature scheme in order to reduce the misusing of re-signing keys.	PBC Library	1. Better user revocation time 2. Reliability 3. Enhance the user revocation efficiency
Knox: Privacy Preserving Auditing Scheme	Wang et al [50]	2012	Knox employs group signatures and homomorphic MACs for verifying and storing the shared data respectively.	GMP and PBC Library	1. Independent auditing time (from the size of the group) 2. Correctness 3. Traceability 4. Identity privacy

Cloud Group Based Data Sharing Schemes					
Key-Aggregate Model	Shaik and Amantulla (Shaik and Amantulla 2015)	2015	This model provides an efficient and flexible key delegation using Key Aggregate Cryptosystem (KAC).	PBC Library	1. Constant-size keys 2. Save spaces 3. Minimized bandwidth
Dynamic Secure Group Sharing Framework	Xue et al [51]	2014	When the group member joins or leaves, this framework supports the group key pair updating.	PBC Library	1. Low computational complexity 2. Low communication overhead
Mona: Secure Multi Owner Data Sharing Model	Liu et al [52]	2013	Mona uses both group signature and the dynamic broadcast encryption methods for securely sharing the data with others, including new joining users.	GMP Library, Miracl Library, and PBC Library	1. Guarantees efficiency 2. Data confidentiality 3. Anonymity and traceability 4. Better access control
Medical Record Based Data Sharing Schemes					
Privacy Preserving Medical Data Sharing Model	Yang et al [53]	2015	This system offers better balance between the information utilization and privacy protection by vertical data partition.	Visual C++ (Version 6.0)	1. Maintain information loss 2. Better encryption time 3. Better running time
Secure Medical Data Exchange Protocol	Chen et al [54]	2014	This protocol employs the asymmetric encryption method for protecting the information of the patient.	PBC Library	1. Short transmission time 2. Low computation cost 3. Resist against various attacks
Privacy Aware Attribute-Based Personal Health Record (PHR) Sharing Model	Xhafa et al [55]	2014	In this system, the multi-authority Cipher-text Policy Attribute-Based Encryption (CP-ABE) is used to accomplish user accountability.	PBC Library	1. Consumes less time 2. Better computation cost for both PHR owners and users

Crypt Based Data Sharing Schemes					
Revocable-Storage Identity-Based Encryption (RS-IBE) Method	Wei et al [56]	2015	This technique simultaneously updates the cipher-text and supports identity revocation using ℓ-Bilinear Diffie-Hellman Exponent (ℓ-BDHE)	PBC Library	1. Low communication cost 2. Low storage cost 3. Less time complexity
Ciphertext Policy-Attribute Based Encryption (CP-ABE) Method	Xu et al [57]	2015	The authorized users are protected from being misled during delegation using CP-ABE along with the Verification Delegation (VD).	GMP Library	1. Low computation cost 2. Data confidentiality
Pairing-Free Certificate Based Proxy Re-Encryption Method	Lu and Li [58]	2015	In this method, the chosen-cipher text security is accomplished without the operation of bilinear pairing based on Schnorr's signature technique.	PBC Library	1. Better efficiency 2. Low computation cost
Fine Grained Proxy Re-Encryption Method	Yang et al [59]	2015	This method attains the user revocation by removing the re-encryption key of the revoked users from the cloud server (i.e. proxy).	Bouncy Castle Java Crypto Library	1. Low communication overhead 2. Less computational cost
Mediated Certificate-Less Public Key Encryption (mCL-PKE) Method	Seo et al [60]	2014	This method assures the data confidentiality and does not suffer from key escrow problem with the pairing-free and SEM approaches.	GMP Library, PBC Library, and Number Theory Library (NTL)	1. Minimizes the overall overhead 2. Low computational complexity

RESEARCH ARTICLE

A Study on the Effects of Injection Water Quality on Oil Recovery during Water Flooding in Geleki Oil Field of the Upper Assam Basin, India

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ABSTRACT

The quality of Injection Water plays a major role in the performance of water flooding programs. Poor Injection Water quality deteriorates the Crude Oil/Brine/Rock (COBR) system of a reservoir through plugging of pore spaces, wettability alteration of rock, and alteration of oil-brine Interfacial Tension (IFT) which can affect the oil recovery. In this work, a detailed study has been made on the Effluent Treatment Plant (ETP) and Water Injection Plant (WIP) along with the COBR system of the Geleki Oil Field of the Upper Assam Basin, India to design the Injection Water for higher oil recovery during water flooding. The quality of the Injection Water is maintained in the ETP through the application of different chemicals like De-oiler, Poly Aluminium Chloride, Poly-electrolyte, Bactericide, Potash, Biocide, and Pressure Sand Filter. In the WIP, Potassium Permanganate, Sodium Hydroxide, Sodium Hypochlorite, Bleaching Powder, Lime, and Alum are used to reduce the turbidity down to 20 NTU. The turbidity is further reduced to below 0.5 NTU by using Pressure Sand Filter and Dual Media Filter. The Physicochemical Parameters of the Raw Effluent, Treated Effluent, and Treated Injection Water are studied in detail to optimize the Injection Water composition for higher oil recovery. Also, the Petrographic Analysis of the Reservoir Rock was done to understand the COBR interaction during water flooding. It is observed that the rock samples of the reservoir contain Mica, Plagioclase Feldspar, Illite, Kaolinite, and Smectite. The analysis of the water in the ETP and WIP shows that the Filterability, Turbidity, Total Suspended Solids (TSS), and Sulfate Reducing Bacteria (SRB) of Treated Effluent Water are above the permissible limit. The Total Iron, Dissolved Oxygen, General Aerobic Bacteria (GAB), and SRB of the treated River and Bore Well Water are also very high. These higher values of Physicochemical Parameter can have detrimental effects on the COBR system of the study area during water flooding which in turn can reduce the oil

recovery efficiency. The treatment of the Produced Effluent and other Injection Water needs to be properly designed to make it compatible with the COBR system for higher oil recovery.

Keywords: COBR, ETP, Filterability, Recovery, Turbidity, Water flooding, WIP.

INTRODUCTION

The production of oil and gas is usually accompanied by the production of water. This produced water consists of the formation brine and/or the flood water injected previously into the formation. The most widely applied Secondary Recovery technique involves the reinjection of this produced water and/or injection of surface water or bore well water into the oil reservoir after proper treatment. Water flooding has been used since the initiation of the oil and gas industry and many oil reservoirs currently in production are applying this technique to improve the oil recovery [1-2].The physical and chemical properties of the produced water mainly depend on the mineralogy, geology, chemical reactions that occurred during the geologic times, microorganisms, hydrocarbon types, pressure, and temperature [3].The major components of the produced water are organic compounds (dissolved and dispersed), dissolved minerals, chemicals, solids, and dissolved gases[4-5].The dissolved organic compounds include hydrocarbons, poly aromatic hydrocarbons, nitrogen compounds, BTEX (benzene, toluene, ethyl benzene, and xylenes), phenols, naphthenic, fatty acids, and humic acid [6] whereas dispersed organic compounds include polycyclic aromatic hydrocarbons and heavy alkyl phenols which are dispersed in the water phase as oil droplets [7].The dissolved minerals include radioactive metals, heavy metals, and other minerals which are made up of anions & cations [8]. The cations are mainly Na^+, K^+, Ca^{2+}, Mg^{2+}, Ba^{2+}, Sr^{2+}, Fe^{2+}, and the anions are Cl^-, SO_4^{2-}, CO_3^{2-}, and HCO_3^-[4]. The different chemicals used during the treatment of injection water and various production stages are scale inhibitors, corrosion inhibitors, emulsion breakers, antifoam agents, biocides, de-emulsifiers, coagulants, solvents etc. [7] which can adversely affect the oil-water separation and increase the toxicity [9].

The presence of solids and dissolved gases in the injection water drastically affect the performance of a water flood project. Different solids like small pieces of reservoir rock, sand, clays, precipitates, scales, paraffin, stimulation products, corrosion products, bacteria etc. are present in the produced water which can reduce the rock permeability by blocking some of the pore throats [9]. Also, the deposition of paraffin, scales, and other precipitants in the tubing affects the fluid flow. The produced water may contain dissolved gases like CO_2, H_2S,and O_2. The presence of a sufficient amount of oxygen can help the growth of bacterial activity[10]whereas, CO_2 and H_2S increase the corrosion of the metallic equipment. On the other hand, the contaminants of the surface water and bore well water are generally suspended solids, marine organisms, bacteria, and dissolved oxygen. The injection of this surface water and bore well water can also adversely affect the COBR system of the reservoir if proper treatment is not done before injection. The quality of the injection water is of paramount significance in the water flood projects as it governs the success of the project. The measurement of water quality, bacterial contamination, and formation compatibility should be accurately accomplished during the management of the injection water quality[11]. It should neither react with the formation brine to form some insoluble precipitants nor creates the clay swelling and clay migration which reduces the rock permeability. During water flooding, particle retention in the pore spaces and plugging of the pore throats have adverse effects on well quality [12]. The plugging of pore spaces near the vicinity of the wellbore leads to the formation of external cake around the injector's wellbore which reduces the permeability [13]. The presence of charged ions and salts in the injection water increases the density, viscosity, Interfacial Tension (IFT), and electrical conductivity [14].This high density and IFT of the injection water leads to an increase in Residual Oil Saturation (ROS) in the reservoir through the reduction of Volumetric Sweep Efficiency and an increase in oil-water IFT. However, if the concentration of the ions in the injection water is lower than the formation brine, Multi-component Ion Exchange (MIE) takes place which changes the wettability of the reservoir rock to a more water-wet condition that improves the recovery of oil [15-16]. The clay swelling and fine migration also occur during the injection of low salinity water in a sandstone reservoir[17-18] which causes the formation damage resulting in the reduction of water flood performance. Earlier studies have found that a high pH of bulk fluid causes the deposition of particles in the

permeable paths of the reservoir rock that increases the formation damage [19]. However, a high pH of the brine in the formation alters the rock wettability in a favorable way and reduces the oil-water Interfacial Tension (IFT) which improves the oil recovery [20-21].The presence of aerobic/anaerobic bacteria, algal, and fungal growth in the injection water causes the plugging of the pore throats of the reservoir and the equipment along with equipment corrosion. The sulfate in the formation brine helps in the growth and reproduction of the Sulphate Reducing Bacteria (SRB)which causes reservoir pore throat plugging. Also, sulfatereacts with SRB to form the Sulphide Ion which later reacts with iron to form Iron Sulphide and increases the plugging tendency [14]. In Upper Assam Basin, injection of water was started in 1983 in the Geleki Oil Field as an Improved Oil Recovery Method (IOR). However, during the flooding process, different problems, such as clay swelling, fine migration, injectivity impairment etc. have been observed. Therefore, this study has been made on the Effects of Injection Water Quality on Oil Recovery during Water flooding in the Geleki Oil Field of the Upper Assam Basin, India.

EXPERIMENTAL WORKS AND ANALYSIS

For the analysis of the reservoir rock, 10 numbers of rock samples were collected from the Geleki Oil Field from a depth range of 2597.50 m to 2854.50m. The Effluent Treatment Plant (ETP) and Water Injection Plant (WIP) of the Geleki Oil Field were studied in detail for the analysis of Effluent Water and Injection Water. The Physicochemical Parameters of the Raw Effluent, Treated Effluent, River Water, Bore Well Water, and Treated Injection Water were studied for the proper design of the injection water for higher oil recovery.

Petrographic Analysis

Petrography is the science that describes and classifies rocks. It is studied under a Petrographic Microscope to determine the rock composition and the textural relations among the rock grains [22]. For this study, the reservoir rock samples of the Geleki Oilfield were studied by Thin Section Analysis and Scanning Electron Microscopic (SEM) Analysis. Figures 1 & 2 are showing the photos of the Petrographic Thin Section and Figure 3 is showing the SEM photomicrographs of the rock samples of the area under study.

Analysis of the Effluent Water Treatment in Effluent Treatment Plant (ETP)

The Effluent Treatment Plant (ETP-I) of Geleki is one of the new installations in Geleki Oil Field which was commissioned on 5th February 1999 to meet wastewater treatment requirements. There area total of 4 nos. of important installations in Geleki Oil Field (3 nos. of Group Gathering Station and 1 no. of Central Tank Farm) from which produced water is being generated which needs to be treated before injection back into the reservoir.

Free Oil Separation and Transfer Facilities

Free oil is separated out in the Wash Tank where sufficient retention time is given. To enhance the free oil separation, De-oiler is added in the inlet of the Wash Tank along with the incoming effluent. De-oiler Dosing Pump is used to pump the De-oiler solution which is prepared at the Chemical House in De-oiler Solution Tank. In the Wash Tank, the oil is accumulated at the top due to density difference and periodically it is removed from the Wash Tank.

Emulsified Oil Separation Facility

Effluent from the Wash Tank is fed to the Settling Tank with the help of Effluent Transfer Pumps. The bottom outlet of the tank is taken into the chemical mixing cum distribution chamber (Flash Fank) by gravity where Alum and Polyelectrolyte chemicals are dosed for demulsification and destabilization of suspended colloidal matters present in wastewater. The wastewater is then distributed into two parallel streams of identical capacity consisting of Flash Mixers and Flocculator. Chemicals are thoroughly mixed in the Flash Mixer where the emulsified oil and colloidal matters get destabilized by the action of metallic coagulants and polyelectrolyte. After destabilization of emulsion and colloidal matters, the mixture of chemical and wastewater enters into Flocculator where two different types of flocs form. The major part of the floc is lighter which is fragile and impregnated with oil & oily materials whereasa small part of the flocs is heavier than water which has a settling tendency.

Sump Tank and Sludge Handling Installations

The flocculated water from the Flocculator Tank enters the Sump Tank which is divided into three parts. In the first part, oily materials float on the top surface and then clear water with some impurities goes into the second part which gets settled in the third part of the Sump Tank. Chemical sludge separated out from the Sump Tank is settled and transferred to the Surge Pond of Central Tank Farm (CTF) through tankers. The clear water of the Sump Tank may contain some impurities in the form of dissolved oil and associated organic matters that may increase the problem for its reuse as injection water. Therefore, the outlet of the Sump Tank unit passes through a series of Pressure Sand Filters (Figure 4). The treated water is then transferred to the Water Injection Plant (WIP) of the Geleki Oil Field.

Chemical Dosage Requirement in ETP

Different chemicals are used for the proper treatment of water in the ETP-I of the Geleki Oil Field. The chemicals along with their doses used using the Chemical Dosing Tank are given in Table 1.The treated water is then transferred to the Water Injection Plant (WIP) of the Geleki Oil Field. Figure 5 shows the whole Process Flow Diagram of the Effluent Treatment Plant (ETP-I) of the Geleki Oil Field (ONGC Unpublished Report).

Analysis of the Injection Water Treatment inWater Injection Plant (WIP)

The Water Injection Plant (WIP) of Geleki is one of the oldest installations in Geleki Oil Field which was commissioned on 15th September 1982, and the water injection was initiated in the TS-5A sand. Before injection, the treatment of the injection water is done through different stages mainly to reduce the iron content and turbidity so that it becomes compatible with the COBR system of the reservoir.

Cascade Aerator, Flocculation Tank and Plate Clarifier

In the first stage, the turbidity of the injection water is reduced by adding a few chemicals and allowing the particles to settle. Chemicals added in the WIP of Geleki Oil Field are Potassium Permanganate, Sodium Hydroxide, and Sodium Hypochlorite in the pre-treatment stage. The injection water is then stored in the Raw Water Tank from where it goes to the Cascade Aerator. The Cascade Aerator aerates the raw water to remove the iron present in the water. Aerated water then flows under gravity to the Flocculation Tank. Before entering the Flocculation Tank, raw water is dosed with Bleaching Powder, Lime, Alum, and Potassium Permanganate. The chemically treated water then flows by gravity to the Flash Mix Chamber of the Flocculation Tank where it is subjected to rapid mixing to influence propercoagulation. Then the coagulated water enters the Flocculation Chamber of the Tank where the water is subjected to slow agitation by means of Flocculating Paddles. The flocculated water from Flocculation Tank then flows to the Plate Clarifier by gravity which clarifies the flocculated raw water down to 20 NTU turbidity. The sludge settles on the plates and slides down which is collected in the sludge hopper. The sludge is then drained from the Plate Clarifier bottom and taken to Sludge Settler by the hydraulic head. The clarified water overflows into the Pump Pit from where it is pumped to Primary Pressure Sand Filters. The details of the Cascade Aerator, Flocculation Tank, and Plate Clarifier of WIP of Geleki are given in Table 2 (ONGC Unpublished Report).

Pressure Sand Filters and Dual Media Filters

The clarified water coming out from the Plate Clarifier is then pumped to the Treated Water Tanks from where the water is passed through the Pressure Sand Filters (Stage-II) which brings the turbidity of water down to 2 NTU. The filtered water is then pumped to the Dual Media Filters where the turbidity of the water is brought down to 0.5 NTU. Finally, the filtered water flows directly to the high-pressure Water Injection Pumps. The details of the Pressure Sand Filters and Dual Media Filters are given in Table 3 and Table 4 respectively (ONGC Unpublished Report). The Process Flow Diagram of the Water Injection Plant of the Geleki Oil Field is also shown in Figure 6 (ONGC Unpublished Report). In the study area, the injection water is a mixture of the treated Geleki Effluent, River Water, and Bore Well Water. The Physicochemical Parameters of the Geleki Effluent and the water from the River and Bore Well are given in Tables 5 and 6 respectively [23].

RESULTS AND DISCUSSION

The factors that affect the oil recovery during water flooding are reservoir and fluid characteristics. These characteristics include structure, depth, lithology, homogeneity, porosity, permeability, rock wettability, fluidsaturation, and fluid viscosity [24].Earlier studies have found that the performance of a water flood project strongly depends on the flood pattern, fluid mobilities, and reservoir heterogeneity [25]. However, recent studies have found that the composition and the chemistry of the injection water also play a vital role in the effects of the COBR system and oil recovery during water flooding [23, 26-29].Earlier studies have found that the impaired injectivity is directly related to the injection water quality which can create the formation damage through Mechanically Induced Damage (solid injection and fines migration), Injection Water-Formation Rock Interaction (clay swelling, clay deflocculation, formation dissolution, wettability alteration), Injection Water-Reservoir Fluid Interactions (formation and precipitation of insoluble scales, emulsification and emulsion blocks and asphaltene/wax deposition),Relative Permeability Effects (oil and gas entrainment) and Biologically Induced Impairment (bacterial entrainment and its growth)[26].Therefore, the study of the injection water quality along with the composition of the reservoir rock and fluids are very important to understand their interactions among them which can affect the oil recovery.

The petrographic analysis of the rock of the Geleki Oil Field reveals that Smectite and Illite clay minerals are present along with Plagioclase Feldspar and Mica. Clay minerals are built from layers (sheets) of SiO_4 tetrahedrons and octahedrons like $Al_2(OH)_6)n$ or $((Fe \text{ or } Mg)_3(OH)_6)n$ which are stacked on top of each other. The Smectite Group of clay minerals has a 2:1 layer structure which can expand and contract its layers because the interlayer cations (Na^+, Mg^{2+}, Ca^{2+}, K^+, Li^+, etc.) are attracted more to the surrounding water than to the relatively small layer charge [30].During water flooding, if the injection water salinity is lower than the salinity of the formation brine, swelling of Smectite occurs which can reduce the rock permeability. It is also observed that, under favorable colloidal conditions, Illite and Micadetach from the rock surfaces and migrated along with the injection water[18, 31]. These migrated fines can get trapped in the pore throats which can further reduce the rock permeability. From the earlier studies, it is observed that Kaolinite is present in the rock matrix of the study area[32]. Kaolinite is wetted preferentially by oil in a sandstone reservoir which partially mobilizes during water flooding due to the competition between the colloidal and mechanical forces [33-36].As the grain size of kaolinite is large, most of the migrated kaolinite particles failed to pass through the pore spaces which can reduce the permeability of the flooded zone by partially blocking some of the pore-throats. However, kaolinite mobilization can enhance the recovery of oil by reducing the oil-water Interfacial Tension (IFT) as this mixed-wet clay acts as an interface stabilizing agent[35].It is also found that during water flooding, more migration of kaolinite occurs which improves the oil recovery if the salinity of the injection water is lower than the formation brine salinity[17, 37]. The presence of Plagioclase Feldspar in the reservoir rock indicates that it can form new flow channels in the formationdue to its tendency to split along the cleavage [38].This Plagioclase Feldspar also strongly indicates that the area under study can improve the oil recovery through the injection of low saline water[39].On the other hand, the Potassium Feldspar is likely to dissolve along its cleavage forming the secondary pores which can improve the rock permeability[38].

The presence of the polar compounds (resin and asphaltene) in the crude oil of Geleki Oil Field was observed in the earlier studies[32]. It is found that these polar compounds of oil can adsorb onto the clay surfaces by either Ligand Bridging or Cation Exchange or Cation Bridging or Water Bridging Mechanisms which makes the rock more oil-wet [40]. In these mechanisms, clay minerals and divalent cations (Mg^{2+} and Ca^{2+}) of surrounding water play a major role. It has already been found that the formation brine of the Geleki Oil Field which has a salinity (as NaCl) of 1404 ppm contains 8 ppm Mg^{2+} and 6 ppm Ca^{2+}ion [32].Recent studies have shown that, by changing the chemistry of the injection water, the wettability of a sandstone reservoir rock can be altered towards more water-wet which improves the oil recovery[23,41-42]. The study of the treatment of Effluent Water in the Effluent Treatment Plant (ETP) of Geleki Oil Field shows that different facilities are available to separate the free and emulsified oil from the Effluent Water. Free oil is separated out in the Wash Tank where sufficient retention time is given. To separate the emulsified

oil, the Effluent Water is transferred to the Flash Mixers where Alum and Polyelectrolyte chemicals are thoroughly mixed as mentioned above. In the Flocculation Tank, the emulsified oil and colloidal matters are destabilized where heavier flocks are settled whereas the lighter flocks and the oil droplets occupy the top surface of the water due to gravity. After separating the flocks and the oil from the water in the Sump Tank, the fluid stream passes through the Pressure Sand Filter to remove the impurities. Different chemicals are used in the ETP-I as given in Table 1 to reduce the oil content and bacteria in the treated effluent so that it will not affect the reservoir health. However, it is observed that the Filterability, Turbidity, Total Suspended Solids, and Sulfate Reducing Bacteria of Treated Effluent Water are 0.050 l/30 min, 11.8 NTU, 42 mg/l, and 10^2-10^3 Counts/ml respectively which are above the permissible limits (Table 5). The low Filterability and high TSS & Turbidity of injection water can reduce the reservoir rock permeability by blocking some of the pore throats during water flooding. Also, a high number of SRB causes reservoir pore throat plugging. In addition to this, sulfate reacts with SRB to form the Sulphide Ion which then reacts with iron to form Iron Sulphide and increases the plugging tendency as mentioned earlier.

The River and Bore well water are treated in the Water Injection Plant of the Geleki Oil Field where Cascade Aerator, Flocculation Tank, Plate Clarifier, Pressure Sand Filters, and Dual Media Filters are used to reduce the iron content and turbidity of the water. Different chemicals like Potassium Permanganate, Sodium Hydroxide, Sodium Hypochlorite, Bleaching Powder, Lime, Alum, and Potassium Permanganate are mixed with the water during its treatment in the Cascade Aerator and Flocculation Tank as mentioned above. The flocculated water is then flowing to the Plate Clarifier by gravity where the turbidity is reduced to below 20 NTU. The turbidity of the water is further reduced to below 0.5 NTU in the Pressure Sand Filters and Dual Media Filters where gravel, sand, and anthracite are used as filter media (Tables 3 and 4). But it is observed that Iron Content, Dissolved Oxygen, GAB, and SRB values of the Treated Injection Water are all higher than the permissible limit (Table 6). The high amount of iron in the injection water can increase the injectivity problem by blocking some of the pore throats in the reservoir rock [43]. Earlier studies have found that injectivity souring and corrosion problems occur during water flooding due to the presence of a high number of GAB and SRB in the injection water [44-47]. The biofilms formed by the bacteria adsorb on the reservoir rock surfaces which causes partial or total pore throat plugging. Moreover, biofilms act as an active site for the accumulation of other solids present in the injection water which further reduces the permeability [26]. The Dissolved Oxygen (0.8 ppm) present in the Treated Injection Water can increase the growth of microorganisms and corrosion of the metallic equipment which can further reduce the rock permeability.

CONCLUSION

A detailed study of the injection water quality has been made in this paper for water flooding in the Geleki Oil Field of the Upper Assam Basin. Most of the Physiochemical Parameters of the Treated Injection Water and Effluent Water are under the permissible limit. However, certain parameters like Filterability, Turbidity, TSS, Iron Content, Dissolved Oxygen, SBR, and GABare above the maximum permissible limit which may adversely affect the Crude Oil/Brine/Rock system of the reservoir and in turn oil recovery. Therefore, proper treatment of the injection water is needed to maintain those parameters for improving the water flood performance in the study area.

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Table 1. Chemicals and their doses used in ETP-I of the geleki oil field (ongc unpublished report)

Sl. No.	Chemicals Used	Dosage (ppm)
1	Poly Aluminium Chloride (PAC) or Alum	60-150
2	De-oiler	8-10
3	Poly-electrolyte or Polypusher	1-3
4	Bactericide(Sodium Hypochlorite)	10-50
5	Potash($KMnO_4$)	5
6	Biocide(Amine & aldehyde) (used alternate week)	360-400

Table 2. Details of the cascade aerator, flocculation tank and plate clarifier

Static Equipment Details	Cascade Aerator	Flocculation Tank	Plate Clarifier
No. of Units	1	1	1
Capacity	300 m^3/hr	300 m^3/hr	300 m^3/hr
Size (Dia. x Ht.)	4000 x 5650	5700 x 4650	-
Material of Construction	Reinforced Cement Concrete	Carbon Steel Epoxy Painted	Carbon Steel Epoxy Painted

Table 3. Pressure sand filter

Filter details	1st& 2nd Stage Pressure Sand Filters
No. of Units	1st Stage-3 Nos., 2nd Stage-3 Nos.
Capacity (m^3/hr)	90
Mode of Operation	Series/ Parallel
Shape of Equipment	Vertical cylindrical with dished ends
Dimensions(Dia. × Ht.) mm^2	2400 x 2300
M.O.C.	Carbon Steel Epoxy Painted
Filter media	Gravel (440 mm Ht.) Sand (915 mm Ht.)

Table 4. Dual media filter

Filter details	Primary Dual Media Filter	Secondary Dual Media Filter
No. of units	6	3
Capacity (m^3/hr)	90	15
Mode of operation	Series/ Parallel	Series/ Parallel
Shape of Equipment	Vertical cylindrical with dished ends	Vertical cylindrical with dished ends
Size (Dia. x Ht.) mm^2	2400 x 2300	1000 x 2300
M.O.C.	Carbon Steel Rubber-Lined	Carbon Steel Rubber-Lined
Filter media	Gravel (440 mm Ht.), Quartz Sand (550 mm Ht.) Anthracite (350 mm Ht.)	Gravel (440 mm Ht.), Quartz Sand (550 mm Ht.) Anthracite (350 mm Ht.)

Table 5. Physicochemical parameters of geleki effluent

Sl. No.	**Parameter**	**Unit**	**Raw Effluent**	**Treated Effluent**	**Limitation**
1	pH	-	7.58-7.66	6.89	6.5-8.5
2	Filterability	l/30min	0.020-0.025	0.050	>5
3	T.S.S.	mg/l	160-465	42	<2.5
4	Turbidity	NTU	218-640	11.8	<0.5
5	Total Iron	mg/l	6.06	0.98	<0.1
6	Dissolved Oxygen	ppm	1.1	-	Nil
7	Residual Chlorine	ppm	-	Nil	0.2
8	Chlorine Demand	ppm	9.4	-	-
9	GAB	Counts/ml	(1-10) $\times 10^4$	10^2-10^3	<(1-10) $\times 10^3$
10	SRB	Counts/ml	(1-10) $\times 10^4$	10^2-10^3	Nil
11	Oil & Grease	mg/l	756	8	<10

Table 6.Physiochemical Parameters Of River Water, Bore Well Water And Treated Injection Water

Sl. No.	**Parameter**	**Unit**	**River Water**	**Bore Well Water**	**Treated Injection Water**	**Limitation**
1	pH	-	7.19	7.20	6.80	6.5-8.5
2	Filterability	l/30 min	1.0	1.1	5.80	>5
3	T.S.S.	mg/l	3.1	10.45	1.58	<2.5
4	Turbidity	NTU	4.2	1.45	0.47	<0.5
5	Total Iron	mg/l	0.76	7.49	0.28	<0.1
6	Dissolved Oxygen	ppm	6.2	3.8	0.8	Nil
7	Residual Chlorine	ppm	-	-	1.0	0.2
8	Chlorine Demand	ppm	0.3	5.6	-	-
9	GAB	Counts/ml	10^5-10^6	10^2-10^3	10^4-10^5	<(1-10) $\times 10^3$
10	SRB	Counts/ml	10-10^2	Nil	10^2-10^3	Nil
11	Chloride	mg/l	21	28	1633	-

Figure 1: Photo of Petrographic Thin Section of the rock sample showing Mica.

Figure 2: Photo of Petrographic Thin Section of the rock sample showing Plagioclase Feldspar and Sedimentary Rock Fragment.

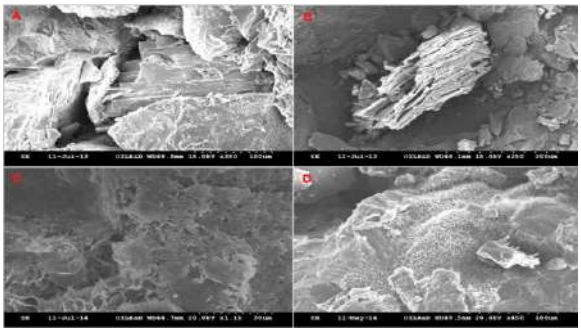

Figure 3: Scanning Electron Microscopic Analysis of the rock samples showing Feldspar (A), Mica (B), Illite (C), and Smectite (D).

Figure 4: Pressure Sand Filter

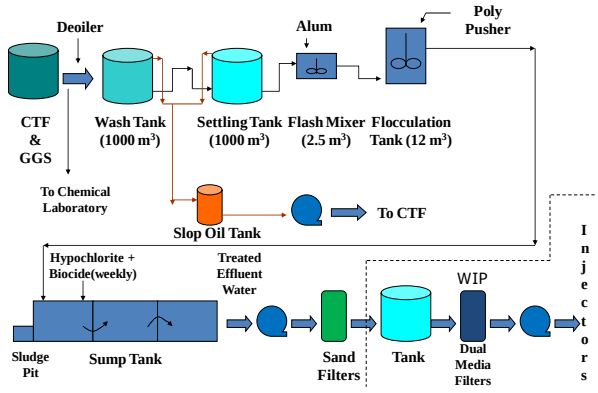

Figure 5: Process Flow Diagram of Effluent Treatment Plant (ETP-I) of Geleki Oil Field.

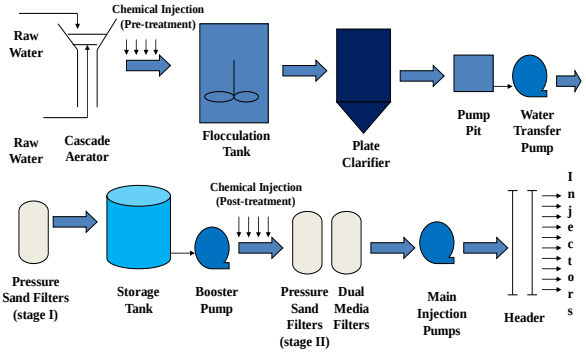

Figure 6. Process Flow Diagram of Water Injection Plant (WIP) of Geleki Oil Field.

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RESEARCH ARTICLE

On Faintly Upper and Lower Precontinuous Multifunctions in Intuitionistic Topological Spaces

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ABSTRACT

This research paper introduces the concept of$\mathcal{U}\mathcal{p}^{\#}\mathfrak{F}_{I^{(T)}P}\#CON$ and $\mathcal{L}\mathcal{o}^{\#}\mathfrak{F}_{I^{(T)}P}\#CON$Intuitionistic topological spaces with multifunctions. These functions' fundamental characteristics and characterizations are established.

Keywords: $\mathcal{U}\mathcal{p}^{\#}\mathfrak{F}_{I^{(T)}P}\#CON$, $\mathcal{L}\mathcal{o}^{\#}\mathfrak{F}_{I^{(T)}P}\#CON$, $\mathfrak{e}_{I}^{(I^{T}P)}$-space, $\mathfrak{e}_{\theta}^{I^{T}}$-space

INTRODUCTION

K.T.Atanassov[1] proposed intuitionistic fuzzy sets in 1986. D. Coker [9] introduced intuitionistic sets and intuitionistic points in 1996. D. Coker [8] presented intuitionistic fuzzy topological spaces in 1997. D. Coker [10] studied intuitionistic topological spaces in 2000. Separation axioms in intuitionistic topological spaces were developed by S. Bayhan and D. Coker [6] in 2001. Pairwise separation axioms in intuitionistic topological spaces, introduced by S. Bayhan and D. Coker [7] in 2005, Categorical Property of Intuitionistic Topological Spaces was first published in 2009 by Lee, Seok-Jong[11]. $I^{(T)}\alpha$-open and $I^{(T)}\beta$-open sets in intuitionistic topological spaces were described by P.Basker and V.Kokilavani [2] in 2016. In Intuitionistic Topological Spaces, P.Basker [3,4] proposed the notions of $\mathrm{T}_{\mathrm{i}}^{\mathrm{I}^{(\mathrm{T})}}\beta$ (i = 0, 1, 2)-Spaces and $(\mathrm{I}^{(\mathrm{T})}\alpha, \mathrm{D})$-Sets in 2018. P.Basker [5] determined the spaces $\mathcal{R}^{0}{}_{\widetilde{\mathrm{I}^{(\mathrm{T})}\beta}}$ and $\mathcal{R}^{1}{}_{\widetilde{\mathrm{I}^{(\mathrm{T})}\beta}}$ in Intuitionistic Topological Spaces and demonstrated some of their characteristics in 2019.

Definition 1.1. [2]An Intuitionistic set $U = \langle \mathbb{X}, U^1, U^2 \rangle$ in an $IST(\mathbb{X}, T)$has been shown to beintuitionistic pre-open if $U \subseteq I^{(T)}i\left(I^{(T)}i(U)\right)$. The family of all $I^{\mathrm{T}}P\text{-}OS$ of an $ITS(\mathbb{X}, T)$ will be represented by$I^{\mathrm{T}}PO(\mathbb{X})$. By a multi-function $\mathfrak{F}: \mathbb{X} \to \mathbb{Y}$, We're talking about a point-to-set connection.$\mathbb{X}$into$\mathbb{Y}$, Moreover, we invariably assume$\mathfrak{F}(f_1) \neq \varphi_{\sim} \forall f_1 \in \mathbb{X}$. For something like a multi-function device$\mathfrak{F}: \mathbb{X} \to \mathbb{Y}$, the inverses of any subset's upper and lower subsetsU_1 of $\mathbb{Y}$are

clearly indicates by $\mathfrak{F}^{(+)}(U_1)$ and $\mathfrak{F}^{(-)}(U_1)$ respectively, where $\mathfrak{F}^{(+)}(U_1) = \{ f_1 \in \mathbb{X} : \mathfrak{F}(f_1) \subset U_1\}$ and $\mathfrak{F}^{(-)}(U_1) = \{f_1 \in \mathbb{X}: \mathfrak{F}(f_1) \cap U_1 \neq \varphi_{\sim} \}$. In specific, $\mathfrak{F}^{(-)}(U_1) = f_1 \in \mathbb{X}: y \in \mathfrak{F}(f_1)$ for to each point $\in \mathbb{Y}$. A multi-function $\mathfrak{F}: \mathbb{X} \to \mathbb{Y}$ is said to be surjective if $\mathfrak{F}(f_1) = y$. A multi-function $\mathfrak{F}: \mathbb{X} \to \mathbb{Y}$ is said to be lower $I^{\mathrm{T}}P$-continuous (resp. upper $I^{\mathrm{T}}P$-continuous) multi-function if $\mathfrak{F}^{(-)}(U_1) \in I^{\mathrm{T}}PO(\mathbb{X})$ (resp.$\mathfrak{F}^{(+)}(U_1) \in I^{\mathrm{T}}PO(\mathbb{X})$).

$\mathcal{U}\mathcal{p}^{\#}\mathfrak{F}_{I^{(T)}P}\#CON$ and $\mathcal{L}\mathcal{o}^{\#}\mathfrak{F}_{I^{(T)}P}\#CON$ MULTIFUNCTIONS

Definition

A point $t_1 \in T$ is called a $I^{(T)}\theta$-cluster argument of T_1if $I^{(T)}c(O) \cap T_1 \neq \varphi_{\sim}$,for every$OS,O$ of Thavingt_1. The set of all $I^{(T)}\theta$-cluster arguments of T_1 is named the $I^{(T)}\theta$-closure of T_1 and is denoted by$I^{(T)}c^{\theta}(T_1)$. If $T_1 = I^{(T)}c^{\theta}(T_1)$, then T_1 is said to be $I^{(T)}\theta$-closed. The complement of a $I^{(T)}\theta$-CS is said to be $I^{(T)}\theta$-OS. Noticeably, T_1 is $I^{(T)}\theta$-OS $\Leftrightarrow$for to each$t_1 \in T_1$,$\exists$ an OS,P such that $t_1 \in P \subset I^{(T)}c(P) \subset T_1$.

Definition

A multi-function $\mathfrak{F}: \mathbb{X} \to \mathbb{Y}$is said to have been:

- Upper Faintly-$I^{\mathrm{T}}P$-continuous (briefly. $\mathcal{U}\mathcal{p}^{\#}\mathfrak{F}_{I^{(T)}P}\#CON$) at $f_1 \in \mathbb{X}$ if for to each$I^{\mathrm{T}}\theta$-OS,Z_2 of $\mathbb{Y}$ containing $\mathfrak{F}(f_1)$, $\exists Z_1 \in I^{\mathrm{T}}PO(\mathbb{X})$ containing $f_1$as a result $\mathfrak{F}(Z_1) \subset Z_2$;
- Lower Faintly-$I^{\mathrm{T}}P$-continuous(briefly.$\mathcal{L}\mathcal{o}^{\#}\mathfrak{F}_{I^{(T)}P}\#CON$) at $f_1 \in \mathbb{X}$ if for to each $I^{\mathrm{T}}\theta$-OS,Z_2 of $\mathbb{Y}$as a result$\mathfrak{F}(f_1) \cap Z_2 \neq \varphi$, $\exists Z_1 \in I^{\mathrm{T}}PO(\mathbb{X})$ containing $f_1$as a result$\mathfrak{F}(z_1) \cap Z_2 \neq \varphi_{\sim}$ for every $z_1 \in Z_1$;

RESULT

Since every $I^{\mathrm{T}}\theta$-OSisOS, it is clear that every$\mathcal{U}\mathcal{p}^{\#}\mathfrak{F}_{I^{(T)}P}\#CON$($\mathcal{L}\mathcal{o}^{\#}\mathfrak{F}_{I^{(T)}P}\#CON$)-multifunction is $\mathcal{U}\mathcal{p}^{\#}\mathfrak{F}_{I^{(T)}P}\#CON$ ($\mathcal{L}\mathcal{o}^{\#}\mathfrak{F}_{I^{(T)}P}\#CON$)-multifunction.

Theorem

For something like a multi-function : $L_1 \to L_2$, The following are comparable:

(a) $\mathfrak{F}$ is $\mathcal{U}\mathcal{p}^{\#}\mathfrak{F}_{I^{(T)}P}\#CON$;

(b) In each case, $f_1 \in L_1$ and for to each $I^{\mathrm{T}}\theta$-OS,Z_2as a result$f_1 \in \mathfrak{F}^{(+)}(Z_2)$, $\exists$ a $I^{\mathrm{T}}P$-OS,Z_1 containing $f_1$as a result$Z_1 \subset \mathfrak{F}^{(+)}(Z_2)$;

(c) In each case, $f_1 \in L_1$ and for each $I^{\mathrm{T}}\theta$-CS,Z_2as a result$x \in \mathfrak{F}^{(+)}(L_2 - Z_2)$, $\exists$ a $I^{\mathrm{T}}P$-CS,Las a result$f_1 \in L_1 - L$ and $\mathfrak{F}^{(-)}(Z_2) \subset L$;

(d) $\mathfrak{F}^{(+)}(Z_2)$is $I^{\mathrm{T}}P$-$OS$for any simple fact$I^{\mathrm{T}}\theta$-OS,Z_2 of L_2;

(e) $\mathfrak{F}^{(-)}(Z_2)$is $I^{\mathrm{T}}P$-CSin any case $I^{\mathrm{T}}\theta$-CS, Z_2 of L_2;

(f) $\mathfrak{F}^{(-)}(L_2 - Z_2)$ is $I^{\mathrm{T}}P$-CS for any $I^{\mathrm{T}}\theta$-OS, Z_2 of L_2;

(g) $\mathfrak{F}^{(+)}(L_2 - Z_2)isI^{\mathrm{T}}P$-$OS$ for any $I^{\mathrm{T}}\theta$-CS, Z_2 of L_2.

Proof.

$(a) \Leftrightarrow (b)$: Clear.

$(b) \Leftrightarrow (c)$: Let $f_1 \in L_1$ and Z_2 be a $I^{\mathrm{T}}\theta$-CS of L_2as a result$f_1 \in \mathfrak{F}^{(+)}(L_2 - Z_2)$. By (b), $\exists$ a $I^{\mathrm{T}}P$-OS,Z_1 containing$f_1$as a result$Z_1 \subset \mathfrak{F}^{(+)}(L_2 - Z_2)$. Thus $\mathfrak{F}^{(-)}(Z_2) \subset L_1 - Z_1$. Take $L = L_1 - Z_1$. Then $f_1 \in L_1 - L$ and L is $I^{\mathrm{T}}P$-CS. The converse issimilar. $(a) \Leftrightarrow (d)$: Let $f_1 \in \mathfrak{F}^{(+)}(Z_2)$ and Z_2 be a $I^{\mathrm{T}}\theta$-OS. By(a), $\exists$ a $I^{\mathrm{T}}\theta$-OS,Z_{f_1} containing $f_1$as a result$Z_{f_1} \subset \mathfrak{F}^{(+)}(Z_2)$. Thus, $\mathfrak{F}^{(+)}(Z_2) = \bigcup_{f_1 \in \mathfrak{F}^{(+)}(Z_2)} Z_{f_1}$. Since any union of $I^{\mathrm{T}}P$-OS is $I^{\mathrm{T}}P$-OS,$\mathfrak{F}^{(+)}(Z_2)$ is $I^{\mathrm{T}}P$-OS. The converse is clear. $(d) \Leftrightarrow (g)$and $(e) \Leftrightarrow (f)$: Clear. $(d) \Leftrightarrow (f)$: Follows from the fact that$\mathfrak{F}^{(-)}(Z_2) = L_1 - \mathfrak{F}^{(+)}(L_2 - Z_2)$.

Observation

For something a : $L_1 \to L_2$, the following areequivalent:

(a) $\mathfrak{F}$ is$\mathcal{L}\mathcal{o}^{\#}\mathfrak{F}_{I^{(T)}P}\#CON$;

(b) For each $f_1 \in L_1$ and for each $I^{\mathrm{T}}\theta\text{-}OS, Z_2$as a result$f_1 \in \mathfrak{F}^{(-)}(Z_2)$, $\exists$ a $I^{\mathrm{T}}P\text{-}OS, Z_1$ containing $f_1$as a result$Z_1 \subset \mathfrak{F}^{(-)}(Z_2)$;

(c) For each $f_1 \in L_1$ and for each $I^{\mathrm{T}}\theta\text{-}CS$, Z_2as a result$f_1 \in \mathfrak{F}^{(-)}(L_2 - Z_2)$, $\exists$ a $I^{\mathrm{T}}P\text{-}CS, L$as a result$f_1 \in L_1 - L$ and $F^{+}(V) \subset L$;

(d) $\mathfrak{F}^{(-)}(Z_2)$is $I^{\mathrm{T}}P\text{-}OS$ for any $I^{\mathrm{T}}\theta\text{-}OS, Z_2$ of L_2;

(e) $\mathfrak{F}^{(+)}(Z_2)$ is $I^{\mathrm{T}}P\text{-}CS$ for any $I^{\mathrm{T}}\theta\text{-}CS, Z_2$ of L_2;

(f) $\mathfrak{F}^{(+)}(L_2 - Z_2)$ is $I^{\mathrm{T}}P\text{-}CS$ for any $I^{\mathrm{T}}\theta\text{-}OS, Z_2$ of L_2;

(g) $\mathfrak{F}^{(-)}(L_2 - Z_2)isI^{\mathrm{T}}P\text{-}OS$ for any $I^{\mathrm{T}}\theta\text{-}OS, Z_2$ of L_2.

Theorem

Suppose that an $ITS(\mathbb{X}, T)$ and $ITS(\mathbb{X}_j, T_j)$where$j \in J$. Let$\mathfrak{F}: \mathbb{X} \to \prod_{j\in J} \mathbb{X}_j$ be a multifunctionfrom $\mathbb{X}$ to the product space $\prod \mathbb{X}_{j\,j\in J}$ and let $M_j : \prod \mathbb{X}_j \to \mathbb{X}_{j\,j\in J}$be a projection multifunction for each $j \in J$ which is defined by $M_j\left(\left(f_{1_j}\right)\right) = \left\{f_{1_j}\right\}$. If $\mathfrak{F}$ is Upper (resp. Lower) faintly-$I^{\mathrm{T}}P$-continuous, then $M_j \circ \mathfrak{F}$ is $\mathcal{Lo}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$ and $\mathcal{Up}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$ for each $j \in J$.

Proof.

Let Z_{2_j} be a $I^{\mathrm{T}}\theta\text{-}OS$,in $ITS(\mathbb{X}_j, T_j)$. Then$\left(M_j \circ \mathfrak{F}\right)^{(+)}\left(Z_{2_j}\right) = \mathfrak{F}^{(+)}\left(M_j{}^{(+)}\left(Z_{2_j}\right)\right) = \mathfrak{F}^{(+)}(Z_{2_j} \times \prod_{q\neq j} \mathbb{X}_q)$

$$\left(resp.\left(M_j \circ \mathfrak{F}\right)^{(-)}\left(Z_{2_j}\right) = \mathfrak{F}^{(-)}\left(M_j{}^{(-)}\left(Z_{2_j}\right)\right) = \mathfrak{F}^{(-)}\left(V_i \times \prod\nolimits_{q\neq j} \mathbb{X}_q\right)\right)$$

Since $\mathfrak{F}$ is Upper (resp. Lower) faintly-$I^{\mathrm{T}}P$-continuous and since $Z_{2_j} \times \prod_{q\neq j} \mathbb{X}_q$ is a $I^{\mathrm{T}}\theta\text{-}OS$, it follows that $\mathfrak{F}^{(+)}\left(Z_{2_j} \times q\neq j\mathbb{X}q resp.\ \mathfrak{F}(-)Z2j\times q\neq j\mathbb{X}q\right.$ is a $ITP\text{-}OS$,in $ITS(\mathbb{X}, T)$. Hence, $Mj\circ\mathfrak{F}$ is $\mathcal{Lo}\#\mathfrak{F}ITP\#CON$ and $\mathcal{Up}\#\mathfrak{F}ITP\#CON$ for each $j\in J$.

Observation

Let $\mathfrak{F}: L_1 \to L_2$ be a multi-function. If the graph multifunction $G_{\mathfrak{F}}$ of $\mathfrak{F}$ is $\mathcal{Lo}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$ and $\mathcal{Up}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$,then $\mathfrak{F}$ is $\mathcal{Lo}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$ and $\mathcal{Up}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$, where $G_{\mathfrak{F}}: L_1 \to L_1 \times L_2$, $G_{\mathfrak{F}}(f_1) = \{f_1\} \times F(f_1)$.

Observation

Suppose that $ITS(I_1, T_1), (I_2, T_2), (I_3, T_3)$ are$ITS$and$\mathfrak{F}_1: (I_1, T_1) \longrightarrow (I_2, T_2)$, $\mathfrak{F}_2: (I_1, T_1) \longrightarrow (I_3, T_3)$ are multifunctions. Let $\mathfrak{F}_1 \times \mathfrak{F}_2 : I_1 \to I_2 \times I_3$ be the multi-function characterised by$(\mathfrak{F}_1 \times \mathfrak{F}_2)(f_1) = \mathfrak{F}_1(f_1) \times \mathfrak{F}_2(f_1)$each throughout every$f_1 \in I_1$. If $\mathfrak{F}_1 \times \mathfrak{F}_2$ is $\mathcal{Lo}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$and $\mathcal{Up}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$, then$\mathfrak{F}_1$ and $\mathfrak{F}_2$ are $\mathcal{Lo}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$ and $\mathcal{Up}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$.

Observation

If $Q \times W \in I^{\mathrm{T}}PO(\mathbb{X} \times \mathbb{Y})$, then$Q \in I^{\mathrm{T}}PO(\mathbb{X})$ and $W \in I^{\mathrm{T}}PO(\mathbb{Y})$.

Theorem

Suppose that $ITS(\mathbb{X}_j, T_j^1)$ and $ITS(\mathbb{Y}_j, T_j^2)$for each $j \in J$. Let$\mathfrak{F}_j : \mathbb{X}_j \to \mathbb{Y}_j$ be a multifunction each throughout every $j \in J$and let$\mathfrak{F}: \prod_{j\in J} \mathbb{X}_j \to \prod_{j\in J} \mathbb{Y}_j$ be the multifunction characterised by $\mathfrak{F}\left(\left(f_{1_j}\right)\right) = \prod_{j\in J} \mathfrak{F}_j\left(f_{1_j}\right)$. If $\mathfrak{F}$ is $\mathcal{Lo}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$and $\mathcal{Up}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$, then $\mathfrak{F}_j$ is $\mathcal{Lo}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$ and $\mathcal{Up}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$for each $j \in J$.

Proof.

Let Z_{2_j} be a $I^{\mathrm{T}}\theta\text{-}OS$of $\mathbb{Y}_j$. Then $Z_{2_j} \times \prod_{q\neq j} \mathbb{X}_q$is a $I^{\mathrm{T}}\theta\text{-}OS$. Since $\mathfrak{F}$is $\mathcal{Lo}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$and $\mathcal{Up}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$, itfollowsthat$\mathfrak{F}^{(+)}\left(Z_{2_j} \times \prod_{j\neq i} \mathbb{Y}_j\right) = \mathfrak{F}_j{}^{(+)}\left(Z_{2_j}\right) \times \prod_{j\neq i} X_j$ (resp. $\mathfrak{F}^{(-)}\left(Z_{2_j} \times \prod_{j\neq i} \mathbb{Y}_j\right) = \mathfrak{F}_j{}^{(-)}\left(Z_{2_j}\right) \times \prod_{j\neq i} X_j$

).Consequently, it follows that $\mathfrak{F}_j{}^{(+)}\left(Z_{2_j}\right)\left(resp.\mathfrak{F}_j{}^{(-)}\left(Z_{2_j}\right)\right)$is a$I^{\mathrm{T}}P\text{-}OS$. Thus $\mathfrak{F}_j$ is$\mathcal{Lo}^{\#}\mathfrak{F}_{I^{(T)}P}\#CON$ and $\mathcal{U\!p}^{\#}\mathfrak{F}_{I^{(T)}P}\#CON$ for each $j \in J$.

Observation

Suppose that $\mathfrak{F}_1:\mathbb{X}_1 \longrightarrow \mathbb{Y}_1$, $\mathfrak{F}_2:\mathbb{X}_2 \longrightarrow \mathbb{Y}_2$are multifunctions.If $\mathfrak{F}_1 \times \mathfrak{F}_2$ is $\mathcal{Lo}^{\#}\mathfrak{F}_{I^{(T)}P}\#CON$ and $\mathcal{U\!p}^{\#}\mathfrak{F}_{I^{(T)}P}\#CON$, then $\mathfrak{F}_1$and $\mathfrak{F}_2$are $\mathcal{Lo}^{\#}\mathfrak{F}_{I^{(T)}P}\#CON$ and $\mathcal{U\!p}^{\#}\mathfrak{F}_{I^{(T)}P}\#CON$, where $\mathfrak{F}_1 \times \mathfrak{F}_2$ is theproduct multifunction defined as,$\mathfrak{F}_1 \times \mathfrak{F}_2:\mathbb{X}_1 \times \mathbb{X}_2 \to \mathbb{Y}_1 \times \mathbb{Y}_2$,$(\mathfrak{F}_1 \times \mathfrak{F}_2)(f_1, f_2) = \mathfrak{F}_1(x_1) \times \mathfrak{F}_2(x_2)$, where $f_1 \in \mathbb{X}_1$ and $f_2 \in \mathbb{X}_2$.Important to remember that a multifunction $\mathfrak{F}:\mathbb{X} \to \mathbb{Y}$if each is promptly closed, it is said to be promptly closed.$f_1 \in \mathbb{X}$, $\mathfrak{F}(x)$ is closed. Also consider the fact that a space $\mathfrak{F}$ is called $I^{\mathrm{T}}\theta$-normal if any disjoint closed subsets are present$\mathfrak{F}_1$, $\mathfrak{F}_2$of $\mathbb{X}$, $\exists$ two disjoint $I^{\mathrm{T}}\theta\text{-}OS$,$D_1$, D_2 of $\mathbb{X}$ containing $\mathfrak{F}_1$, $\mathfrak{F}_2$ respectively.

Definition

An$ITS(\mathbb{X},\ T)$ is said to be $\mathbf{e}_I^{(I^{\mathrm{T}}P)}\left(resp.\mathbf{e}_\theta^{I^T}\right)$if for each unique pair of pointsf_1&$f_2$of $\mathbb{X}$, $\exists$disjoint $I^{\mathrm{T}}P\text{-}OS$ $(resp.\ I^{\mathrm{T}}\theta\text{-}OS)$ Z_1 and Z_2 of $\mathbb{X}$containingf_1 and f_2, respectively.

Theorem

Let $\mathfrak{F}:\mathbb{X} \to \mathbb{Y}$ be an $\mathcal{U\!p}^{\#}\mathfrak{F}_{I^{(T)}P}\#CON$multi-function and punctually closed from an ITS $\mathbb{X}$into a $I^{\mathrm{T}}\theta$-normal space $\mathbb{Y}$ such that $\mathfrak{F}(f_1) \cap \mathfrak{F}(f_2) = \varphi_{\sim}$for each unique pair of pointsf_1 and f_2 of $\mathbb{X}$. Then $\mathbb{X}$is $\mathbf{e}_I^{(I^{\mathrm{T}}P)}$.

Proof.

Let f_1 and f_2a pair of distinct points of $\mathbb{X}$. Then $\mathfrak{F}(f_1) \cap \mathfrak{F}(f_2) = \varphi_{\sim}$. Since $\mathbb{Y}$ is $I^{\mathrm{T}}\theta$-normal and $\mathfrak{F}$ is punctually closed,$\exists$ disjoint $I^{\mathrm{T}}\theta\text{-}OS$,$Z_1$&$Z_2$ containing $\mathfrak{F}(f_1)$&$\mathfrak{F}(f_2)$, as shown, but $\mathfrak{F}$ is $\mathcal{U\!p}^{\#}\mathfrak{F}_{I^{(T)}P}\#CON$, so itfollowsthat $\mathfrak{F}^{+}(Z_1)$ and $\mathfrak{F}^{+}(Z_2)$ are disjoint$I^{\mathrm{T}}P\text{-}OS$ of $\mathbb{X}$ containing f_1 and f_2, respectively. Hence$\mathbb{X}$is $\mathbf{e}_I^{(I^{\mathrm{T}}P)}$.

Definition

An$ITS(\mathbb{X},\ T)$ is said to be $I^{\mathrm{T}}\theta^{\#}Compact$(resp.$I^{\mathrm{T}}P^{\#}Compact$.) if every $I^{\mathrm{T}}\theta\text{-}OS$ (resp. $I^{\mathrm{T}}P\text{-}OS$) cover of $\mathbb{X}$has a limited number of subcovers. A subset T_1 of an$ITS(\mathbb{X},\ T)$ has been shown to be $I^{\mathrm{T}}\theta$-compact in relative to $\mathbb{X}$ if every single cover ofT_1 by $I^{\mathrm{T}}\theta\text{-}OS$ of $\mathbb{X}$ has a finite subcover ofT_1.

Theorem

If$\mathfrak{F}:\mathbb{X} \to \mathbb{Y}$to be a $\mathcal{U\!p}^{\#}\mathfrak{F}_{I^{(T)}P}\#CON$surjective multifunction such that $\mathfrak{F}(f_1)$ is $I^{\mathrm{T}}\theta^{\#}Compact$relative to$\mathbb{Y}$ for each$f_1 \in \mathbb{X}$. If $\mathbb{X}$is$I^{\mathrm{T}}P^{\#}Compact$, then $\mathbb{Y}$ is $I^{\mathrm{T}}\theta^{\#}Compact$.

Proof.

Let $Z_\delta : \delta \in \Lambda$to be a $I^{\mathrm{T}}\theta\text{-}OS$the cover of$\mathbb{Y}$. Since $\mathfrak{F}(f_1)$ is$I^{\mathrm{T}}\theta^{\#}Compact$ relative to $\mathbb{Y}$ for to each $f_1 \in \mathbb{X}$, $\exists$a limited number of subset $\Lambda(f_1)$ of Λit follows that$\mathfrak{F}(f_1) \subset \cup_{\delta \in \Lambda(f_1)} Z_\delta$. Place$Z(f_1) = \cup_{\delta \in \Lambda(f_1)} Z_\delta$. Then $Z(f_1)$ is a $I^{\mathrm{T}}\theta\text{-}OS$ of $\mathbb{Y}$containing $\mathfrak{F}(f_1)$.Since $\mathfrak{F}$is $\mathcal{U\!p}^{\#}\mathfrak{F}_{I^{(T)}P}\#CON$, it follows that $\mathfrak{F}^{(+)}\left(Z(f_1)\right)$ is a $I^{\mathrm{T}}P\text{-}OS$ of $\mathbb{X}$ containing $\{f_1\}$.Thus the family $\left\{\mathfrak{F}^{(+)}\left(Z(f_1)\right) : f_1 \in \mathbb{X}\right\}$ is a $I^{\mathrm{T}}P\text{-}OS$ cover of $\mathbb{X}$,but $\mathbb{X}$ is $I^{\mathrm{T}}P^{\#}Compact$, so $\exists f_{1_1}$, f_{1_2}, $f_{1_3} \ldots f_{1_n} \in \mathbb{X}$ such that $\mathbb{X} = \cup_{j=1}^{n} \mathfrak{F}^{(+)}\left(Z\left(f_{1_j}\right)\right)$.Hence,

$\mathbb{Y} = \mathfrak{F}\left(\cup_{j=1}^{n} \mathfrak{F}^{(+)}\left(Z\left(f_{1_j}\right)\right)\right) = \cup_{j=1}^{n} \mathfrak{F}\left(\mathfrak{F}^{(+)}\left(Z\left(f_{1_j}\right)\right)\right) \subset \cup_{i=1}^{n} Z\left(f_{1_j}\right) = \cup_{j=1}^{n} \cup_{\delta \in \Lambda(f_{1_j})} Z_\delta$. Hence, $\mathbb{Y}$is $I^{\mathrm{T}}\theta^{\#}Compact$.

For a specified, multi-function $\mathfrak{F}:\mathbb{X} \to \mathbb{Y}$, the graphmulti-function $G_{\mathfrak{F}}:\mathbb{X} \to \mathbb{X} \times \mathbb{Y}$is referred to as$G_{\mathfrak{F}}(f_1) = \{f_1\} \times \mathfrak{F}(f_1)$for every $f_1 \in \mathbb{X}$. It was shown that for a specified multi-function $\mathfrak{F}:\mathbb{X} \to \mathbb{Y}$, $G^{(+)}{}_{\mathfrak{F}}(I_1 \times I_2) = I_1 \cap \mathfrak{F}^{(+)}(I_2)$ and $G^{(-)}{}_{\mathfrak{F}}(I_1 \times I_2) = I_1 \cap \mathfrak{F}^{(-)}(I_2)$where $I_1 \subseteq \mathbb{X}$ and $I_2 \subseteq \mathbb{Y}$. A multi-function $\mathfrak{F}:\mathbb{X} \to \mathbb{Y}$ is referred tobe a point closed$\Leftrightarrow$if for each unique point$f_1 \in \mathbb{X}$, $\mathfrak{F}(f_1)$ is closed in$\mathbb{Y}$.

Definition

If$\mathfrak{F}: J_1 \to J_2$to be a multi-function. A multigraph $Gr(\mathfrak{F}) = \{(f_1, f_2): f_2 \in \mathfrak{F}(f_1), f_1 \in J_1\}$ of $\mathfrak{F}$ is reffered to be $P_{I^{\mathrm{T}}}(\theta)$-$CS$if for to each $(f_1, f_2) \in (J_1 \times J_2) - Gr(\mathfrak{F})$, $\exists$ a $I^{\mathrm{T}}P$-OS,$O_1$and a $I^{\mathrm{T}}\theta$-OS,O_2 containing f_1 and f_2, respectively, follows that$(O_1 \times O_2) \cap Gr(\mathfrak{F}) = \varphi_{\sim}$, *i.e.*,$\mathfrak{F}(O_1) \cap O_2 = \varphi_{\sim}$.

Theorem

If the graph multifunction $\mathfrak{F}: J_1 \to J_2$ is$\mathcal{LO}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$and $\mathcal{UP}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$, then $\mathfrak{F}$ is $\mathcal{LO}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$ and $\mathcal{UP}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$.

Proof.

We shall only prove the case where $\mathfrak{F}$is $\mathcal{UP}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$. Let $f_1 \in J_1$ and O_2 be a $I^{\mathrm{T}}\theta$-OS in J_2 such that $f_1 \in \mathfrak{F}^{(+)}(O_2)$. Then $G_{\mathfrak{F}}(f_1) \cap (J_1 \times J_2) = (\{f_1\} \times \mathfrak{F}(f_1)) \cap (J_1 \times J_2) = \{f_1\} \times (\mathfrak{F}(f_1) \cap O_2) \neq \varphi_{\sim}$ and $J_1 \times O_2$ is $I^{\mathrm{T}}\theta$-open in $J_1 \times J_2$. Since the graph multifunction $Gr_{\mathfrak{F}}$is $\mathcal{UP}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$, $\exists$ an open set O_1 containing f_1 such that $f_3 \in O_1$implies that $G_{\mathfrak{F}}(f_3) \cap (J_1 \times O_2) \neq \varphi_{\sim}$. Therefore, we obtain$O_1 \subseteq Gr^{(+)}{}_{\mathfrak{F}}(J_1 \times O_2) \in I^{\mathrm{T}}P$-$O(J_1)$from the above equalities.Consequently, $\mathfrak{F}$is $\mathcal{UP}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$.

Theorem

If$\mathfrak{F}: \mathbb{X} \to \mathbb{Y}$, to be a point closed multi-function. $\mathfrak{F}$is an$\mathcal{UP}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$ and assume that $\mathbb{Y}$ is regular, then$G(\mathfrak{F})$ is $I^{\mathrm{T}}\theta$-CS with respect to $\mathbb{X}$.

Proof.

Assume$(f_1, f_2) \notin G(\mathfrak{F})$. Then we have $f_2 \notin \mathfrak{F}(x)$.Since $\mathbb{Y}$ is regular, $\exists$ disjointOS,L_1 , L_2 of $\mathbb{Y}$ suchthat $f_2 \in L_1$ and $\mathfrak{F}(f_1) \in L_2$,$V_2$ is also $I^{\mathrm{T}}\theta$-OSin $\mathbb{Y}$. Since $\mathfrak{F}$ is $\mathcal{UP}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$at f_1, $\exists$ an$I^{\mathrm{T}}P$-OS,U in $\mathbb{X}$ containing f_1 such that $\mathfrak{F}(U) \subseteq L_2$.Therefore, we obtain $f_1 \in U, f_2 \in L_1$and $(f_1, f_2) \in U \times L_1 \subseteq (\mathbb{X} \times \mathbb{Y}) - G(\mathfrak{F})$. So $G(\mathfrak{F})$ is $I^{\mathrm{T}}\theta$-CS with respect to $\mathbb{X}$.

Theorem

If$\mathfrak{F}: J_1 \to J_2$to be a point $CS$and $\mathcal{UP}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$ multi-function. If $\mathfrak{F}$ satisfies $f_1 \neq f_2 \Rightarrow \mathfrak{F}(f_1) \neq \mathfrak{F}(f_2)$ and J_2 is regular space, J_1 will be Hausdorff.

Proof.

Let f_1,f_2 be 2-distinct points belong to J_1, then$\mathfrak{F}(x_1) \neq \mathfrak{F}(x_2)$. Since $\mathfrak{F}$ is point closed and J_2 is regular, $\forall n \in \mathfrak{F}(f_1)$ with $n \notin \mathfrak{F}(f_2)$, $\exists I^{\mathrm{T}}\theta$-$OS$,$Z_1$, Z_2containing f_1 and $\mathfrak{F}(f_2)$ respectively such that $Z_1 \cap Z_2 = \varphi_{\sim}$. Since$\mathfrak{F}$ is $\mathcal{UP}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$and $\mathfrak{F}(f_2) \subseteq Z_2$, $\exists$ anOSM containing f_2 such that $\mathfrak{F}(M) \subseteq Z_2$. Thus $m \in M$. Therefore, M and $J_1 - M$ are disjointOS separating $f_1$and f_2.

Theorem

If a multifunction $\mathfrak{F}: \mathbb{X} \to \mathbb{Y}$ is $\mathcal{UP}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$followsthat $\mathfrak{F}(f_1)$ is $I^{\mathrm{T}}\theta^{\#}Compact$ in relative to $\mathbb{Y}$ for to each $f_1 \in \mathbb{X}$ and $\mathbb{Y}$ is $\mathfrak{C}_{\theta}^{I^{\mathrm{T}}}$, the multi-graph $Gr(\mathfrak{F})$ of $\mathfrak{F}$ is $P_{I^{\mathrm{T}}}(\theta)$-$CS$.

Proof.

Let $(f_1, f_2) \in (\mathbb{X} \times \mathbb{Y}) - G(\mathfrak{F})$. Then $f_2 \in Y - \mathfrak{F}(x)$. Since $\mathbb{Y}$is $\mathfrak{C}_{\theta}^{I^{\mathrm{T}}}$, for each $f_3 \in \mathfrak{F}(f_1)$, $\exists$ disjoint $I^{\mathrm{T}}\theta$-open subsets $O_1(f_3)$and $O_2(f_3)$ of $\mathbb{Y}$ containing f_3 and f_2, respectively. Thus $\{O_1(f_3) : f_3 \in \mathfrak{F}(f_1)\}$ is a $I^{\mathrm{T}}\theta$-OS cover of$\mathfrak{F}(f_1)$, but $\mathfrak{F}(f_1)$ is $I^{\mathrm{T}}\theta^{\#}Compact$ relativeto $\mathbb{Y}$, so $\exists f_{3_1}, f_{3_2}, f_{3_3} \ldots f_{3_n} \in \mathfrak{F}(f_1)$such that $\mathfrak{F}(f_1) \subset \cup_{i=1}^{n} U(f_{3_i})$. Put$O_1 = \cup_{i=1}^{n} O_1(f_{3_i})$and $O_2 = \cap_{i=1}^{n} O_2(f_{3_i})$. Then O_1 and $O_2$are $I^{\mathrm{T}}\theta$-OS of $\mathbb{Y}$follows that $\mathfrak{F}(f_1) \subset O_1, f_2 \subset O_2$and $O_1 \cap O_2 = \varphi_{\sim}$. Since $\mathfrak{F}$is $\mathcal{UP}^{\#}\mathfrak{F}_{I^{(\mathrm{T})}P}\#CON$, it follows that $\mathfrak{F}^{(+)}(O_1)$ is a $I^{\mathrm{T}}P$-OS of $\mathbb{X}$. Also $f_1 \in \mathfrak{F}^{(+)}(O_1)$ since $\mathfrak{F}(f_1) \subset O_1$ and $\mathfrak{F}\left(\mathfrak{F}^{(+)}(O_1)\right) \cap O_2 = \varphi_{\sim}$since $O_1 \cap O_2 = \varphi_{\sim}$.Hence, $Gr(\mathfrak{F})$ is $P_{I^{\mathrm{T}}}(\theta)$-closed.

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RESEARCH ARTICLE

Automated Vehicular Accident Detection and Notification System

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ABSTRACT

Transport in India is very popular for various reasons, but the condition of Indian roads is very poor and deplorable resulting in frequent road accidents. On an average, one out of every three motor vehicle accidents result in severe injuries. About 60% of the deaths caused by accidents are due to the unavailability of proper emergency medical facilities within one hour of its occurrence. Hence, there is a need for an automated system which should report the accident without any delay. An accident detection system using GPS (Global Positioning System) and GSM(Global System for Mobile communication)has gained more attention. This work has proposed an Automated Vehicular Accident Detection and Notification System (AVADNS) which provides an effective framework that can identify and report about the accidents. AVADNS uses multiple sensors to monitor different vehicle parameters. Any abnormal changes in the sensor values indicate the occurrence of an accident. AVADNS then sends the GPS location of the vehicle to emergency services via GSM modem. AVADNS makes use of efficient accident detection and avoidance algorithms that provide results with improved precision and also classifies the type of accidents. It also includes a mechanism to avoid faulty detection. Details about the accidents are sent to a server and are stored in a database for future use.

Keywords: Accident, Detection, Avoidance, Notification, GSM, GPS, Sensors

INTRODUCTION

According to statistics, the leading cause of death by injury is road traffic accident. Nearly 1.3 million people die every year on the roads and 20 to 50 million people suffer non-fatal injuries, with many sustaining a disability because of their injury. It is predicted that, if necessary, action is not taken, road traffic crashes can result in the deaths of around 1.9 million people annually by 2020[1]. Recently a report on road accidents by the Ministry of Road Transport Highways reveals that during the year 2016, about 1317 accidents and 413 deaths took place each day,

which is 17 deaths every hour[2]. There are many reasons for an accident to occur, namely: usage of mobile phone while driving, untrained drivers, driving while intoxication, bad road conditions, poor traffic management. However, most of the time it has been observed that the deaths occurred in the road accident are due to the late arrival of the ambulance to the accident spot. Although in most cases the injury is not that severe that we could save the affected lives, but, due to late arrival of emergency services, the injuries turn fatal. Eliminating the time between accident occurrence and first medical assistance can reduces fatalities. This paper proposes a framework AVADNS, which uses various sensors, Global System for Mobile communication (GSM), Global Positioning System (GPS) technologies to report accidents as soon as they occur. This framework is also capable of classifying the accidents based on their type

Related Work

Many researchers have carried out their studies on accident detection system. Accident detection system on highways proposed by Jung Lee [3] predicts the flow of vehicle trace using level spacing distribution as Wigner distribution. This real-time traffic accident prediction relates accident occurrences to real-time traffic data obtained from various detectors. However, the performance of this detection and prediction system is greatly restricted by the number of monitoring sensors, algorithms, weather, traffic flow. Accident detection and reporting system used GPS and microcontroller which detects accidents using velocity difference as the key factor. But there were possibilities of false alarm in the system[4].Chuan-zhi *et al* proposed a freeway incident detection system by using the car air bag sensor and accelerometer sensor, where GPS was used to locate the accident place and GSM was used to send the accident location [5]. A smartphone-based accident detection system was proposed by Jules White and Chris Thompson. However, smart phones are expensive and due to false alarm filter, it may not detect all accidents[6]. AVADNS utilizes the capability of many sensors to monitor the vehicle parameters and detect an accident based on their values. Once an accident is detected, the accident location and accident-related data will be sent to emergency services using the GSM network. The use of multiple sensors along with an efficient accident detection algorithm reduces the false alarms.

MATERIALS AND METHODS

The proposed system, AVADNS consisting of the following units, helps the users to detect the accidents and act accordingly as shown in Figure 1.

Accident Detection Unit

Accident Detection Unit consists of components like accelerometer, proximity sensor and vibration sensors that are used to continuously record a particular vehicle parameter. Sudden changes in these sensor values indicate some type of accident.

Accident Avoidance Unit

Accident Avoidance unit is used as an accident predictor. It warns the driver about some potential accident. It consists of ultrasonic, smoke and alcohol sensors.

Reporting Unit

Reporting unit uses GPS and GSM technologies to get the location of the accident and send short messages to the service centers as Google map link and update the server database.

Alert and Reset

It provides a mechanism to avoid faulty reports. It alerts the driver about the accident. In case of a faulty alert, the driver can press an OK button fitted in this unit and stop the unnecessary reporting by resetting the system. The usage of multiple sensors ensures efficient accident detection. Separate detection and avoidance algorithms provide increased accuracy. False alarm is avoided by the resetting mechanism. The accident data is stored in database for

future use. Further, accidents are classified depending on sensor values. Table 1 shows the different types of accidents.

Implementation

GSM:

GSM is a widely used technology for mobile communication in the world. GSM device has a SIM slot for inserting a sim and is associated with a unique number called the IMEI number. IMEI number is different for each and every hardware kit. Using this module, audio calls, SMS, incoming calls can be made. In AVADNS, the GSM device is used for transmitting data in the reporting unit. The data from GPS is transmitted to given mobile through this GSM itself. In AVADNS, GSM SIM900 is used [7].

Arduino

Arduino boards read analog or digital input signals from different sensors and turn it into an output such as activating a motor, turning LED ON/OFF, connecting to the database and many other actions. Arduino IDE is used to control the board functions by sending a set of instructions to the microcontroller on the board. Any programming language like C++ is used to program the board. In AVADNS, Arduino Mega is used. Arduino IDE is used to implement the system.

GPS

GPS abbreviates Global Positioning System and this is used to detect the latitude and longitude of the particular position and it also shows the exact time. It detects these values anywhere on the earth. In AVADNS, it plays a main role and it is the main source to know the accident spot, or even for theft tracking of the vehicle. GPS gets the coordinates from the satellite every second. GPS is the main component used to track the vehicle. In AVADNS, GPS SIM28ML is used. SIM28ML is a stand-alone or Assisted GPS (A-GPS) receiver. With built-in Low-Noise Amplifier (LNA), SIM28ML can relax antenna requirement and no need for external LNA. This supports various location and navigation applications, including autonomous GPS[8].

Sensors and Threshold

Different types of sensors are used to monitor the various parameters of the vehicle. All sensors act accordingly when the reading exceeds the threshold.

Detection Sensors

Accelerometer(ADXL335) is an inertial, dynamic sensor capable of a vast range of sensing. The sensor can measure the static acceleration of gravity in tilt sensing applications and dynamic acceleration resulting from motion, shock, or vibration. In AVADNS, it is used as the main sensor to detect accident. Table II shows the threshold values for accelerometer[9].

Proximity Sensor

It can detect the presence of nearby objects without having any physical contact. The basic functionality is to emit a beam of electromagnetic radiation like infrared radiation and to look for changes in the field or return signal. It is fitted under the vehicle to measure the ride height. A ride height is the shortest distance between a level surface, and the lowest part of a vehicle. Generally, ride height is between 150 and 190mm. Any other value out of this range indicates a vehicle rollover.

Vibration sensor

It is used to identify sudden impact. If the intensity of impact is high enough, it adds a factor for occurrence of an accident. Rash driving and side swipe accidents can be detected.

Avoidance Sensors

Temperature Sensor

LM35D is used to monitor the temperature. Abnormal rise in temperature adds a factor for occurrence of an accident (when the rate of rise exceeds 7-8 Degrees Celsius) The Range of LM35 is 55C to 150C [10]. Burning of tires and excess heating of the vehicle engine can be identified using this sensor.

Smoke Sensor

Is used to detect smoke inside the vehicle and alcoholic consumption limit of the driver. The limit for Blood Alcohol Level (BAC) is 0.08 g/dL or 800 ppm in US and 0.05 g/dL or 500 ppm in Europe. The threshold of this sensor is 4.5 V[11]. It can be used to detect drunk driving.

Ultrasonic Sensor

Measures the distance to the target by the time taken between the emission and reception. This can be used for collision avoidance. Each type of sensor is placed in appropriate position in the vehicle as shown in Figure2. In AVADNS, Arduino Mega is used for controlling the entire process with a GPS receiver and GSM module. GPS receiver is used for detecting coordinates of the vehicle, GSM module is used for sending the alert SMS with the location of the accident coordinates and the link in Google Map. The system diagram of AVADNS is depicted in Figure 3. Accelerometer(ADXL335) is used for detecting accident or sudden change in any axis. Other sensors are used to continuously monitor the vehicle properties and intimate the system in case the properties exceed a threshold value. The detection and avoidance algorithms are implemented in the Arduino IDE. The type of accident is determined based upon the flow diagram shown in Figure4 and Figure5. An alert unit is used to intimate the driver warning messages or wait for the response of the driver in case of faulty incidents. If the driver does not respond, the system concludes that he is severely injured. In that case, Arduino reads coordinates and sends SMS to the predefined number, police or ambulance or family member with the location coordinates of the accident place. The message also contains a Google Map link to the accident location, so that location can be easily tracked as shown in Figure6.The accident-related data is also stored in a database for further analysis.

ALGORITHMS

The overall working of AVADNS system is shown in Algorithm 1. Algorithm 2 shows how accident is avoided. The notations used in algorithms are shown below:

Algorithm 1: *AVADNS*

Input: Vehicle installed with AVADNS system

Output: Accident detection and reporting

1. Power on
2. Acquire location information of the vehicle using GPS
3. Run Accident Avoidance Unit and Accident Detection Unit simultaneously

Algorithm 2: Accident Avoidance Unit

Input: Sensors Readings

Output: Warning Message

1. Monitor the sensor values
2. **If** UltrasonicReading> Ultrasonic Thresh **then**
   Potential Collision Warning
3. **If** Alcohol Reading>Alcohol Thresh **then**
   Drunk and Drive Warning

4. **If** Smoke Reading> Smoke Thresh **then**
Potential Fire Accident Warning
5.Display warning message on LCD screen and Switch
on Red LED
The working of accident detection and the reporting unit is shown in Algorithm 3 and Algorithm 4 respectively.

Algorithm 3: Accident Detection Unit

Input: Sensor Readings

Output: Detecting the occurrence of Accident
1. Monitor Sensor Values.
2.**If**AccReading>AccThresh **then**
If Proxim Reading>Proxim Thresh **then**
Roll Over Accident
Else
Head on Collision
Else
If Vibr Reading> Vibr Thresh **then**
Hit and Run or Side Swipe Accident

Else

If Temp Reading> Temp Thresh **then**
Fire Accident
3.Turn on Red LED and display "Are You OK?" message in LCD display
4.Wait for a specific duration
If Button Press **then**
False Alarm Detected
Goto 1
Else
Call Reporting Unit

Algorithm 4: Accident Reporting Unit

Input: Modules such as GPS module, GSM module

Output: Message with Google Maps link
1. Acquire GPS data such as latitude, longitude.
2. Generate Google Map Link.
3. Generate SMS containing accident location with Google maps link.
4. Send SMS to Emergency Service and Predefined Mobile Numbers.
5. Update the Accident Data in the database for further processing.

CONCLUSION AND FUTURE DEVELOPMENTS

AVADNS is used for detection of the exact place of accident. This system can also be used in school transport vehicle for the safety of students. Companies providing cab services can make use of this system. Also, the accident-related data stored in the database can be used to find the accident-prone areas. The technological advancement in communication technologies (GSM) and location tracking (GPS) is integrated into the automotive sector to offer an

opportunity for better assistance to people injured in traffic accidents, reducing the response time of emergency services, and increasing the information about the accident just before starting the rescue operation. AVADNS is an intelligent, prototype of automatic accident detection system which automatically detects accident using sensors and informs details about location taken from GPS through GSM to the emergency services and predefined mobile numbers for necessary medical help. Consequently, this will save the precious lives by reducing the response time as rescuers can easily reach the accident location using the Google map link. The system can be extended by monitoring some other parameters of vehicle like overheat or LPG gas leakage. This would result increased accuracy of accident detection. The system can also be made to report when a vehicle goes out of a certain/predecided track. It can be used by companies to track vehicles. It can be modified and used as a theft detection system. By interconnecting a camera to the system, photograph of the accident spot can be obtained.

ACKNOWLEDGEMENT

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Table :1 Types of Vehicle Accidents

Types of Vehicle Accidents	
Type	**Explanation**
Head-on collisions	This type of accident occurs when two vehicles collide front on. This type of accident is often very severe and fatal and the survival chances of the victim are very rare.
Vehicle rollover	This type of accident occurs when a vehicle rollover after colliding with another vehicle or a fixed object. Any vehicle can be rollover after

	colliding with something but cars have a higher percentage than other vehicles.
Sideswipe collisions	These types of accidents occur when two vehicles that are moving parallel to each other, touch each other while moving. Although it is a minor accident but sometimes it becomes severe if a car touches a motorcycle.
Hit-and-run accidents	In this type of accident, a driver hits someone or an animal and runs away.

Table: 2 Threshold G-Forces For Accident Detection

Accident severity	Actual maximum grange specified
No Accident	0-4g
Mild Accident	4-20g
Medium Accident	20-40g
Severe Accident	40+g

(g- force acting on a body due to acceleration)

Table: 3 Notations

Notation Table	
Notation	**Explanation**
AccReading	Accelerometer Reading in ms^{-2}
ProximReading	Proximity Sensor Reading *cm*
VibrReading	Vibration Sensor Reading *V/g*
TempReading	Temperature Sensor Reading in $^{\circ}C$
UltrasonicReading	Ultrasonic Sensor Reading in *m*
AlcoholReading	Alcohol Sensor Reading in *V*
AccThresh	Accelerometer Threshold (in Table 2)
ProximThresh	Proximity Sensor Threshold (greater than 19 cm)
VibrThresh	Vibration Sensor Threshold
TempThresh	Temperature Sensor Threshold (greater than 90 $^{\circ}$C)
UltrasonicThresh	Ultrasonic Sensor Threshold (greater than 4 meters)
Alcoholthresh	Alcohol Sensor Threshold (greater Than 4.5 V)

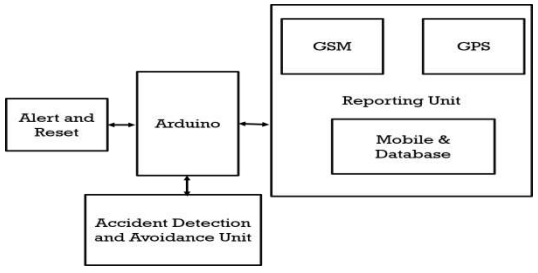

Figure :1 AVADNS Block Diagram

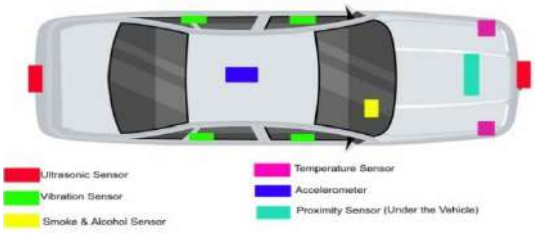

Figure: 2 Sensor Placement

Figure 3. AVADNS System Diagram

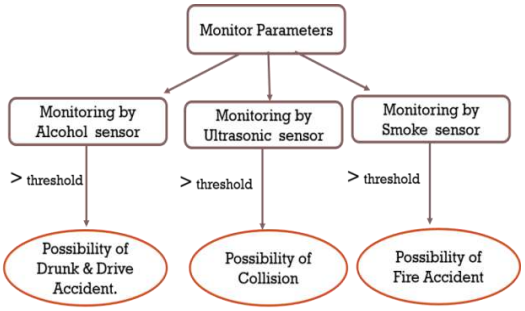

Figure 4. Accident Avoidance Flow Diagram

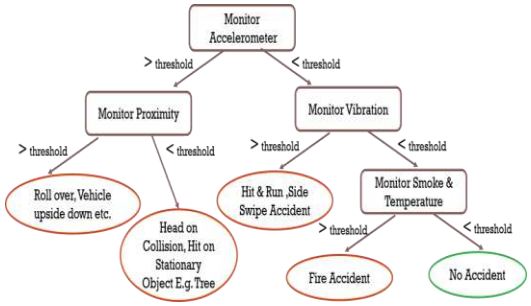

Figure 5. Accident Detection Flow Diagram

Figure 6. Output SMS Received in Phone

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RESEARCH ARTICLE

Dynamics of Cropping Pattern in Tamil Nadu – An Economic Analysis

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ABSTRACT

Agriculture is the backbone of the Indian Economy. The growth of agriculture represents the cropping pattern, which is determined by physical, socio-cultural and historic factors besides technological factors have also played an important role. Changes in cropping pattern in the state have been undergoing changes over a period of time and this resulted in crop diversification. Keeping in view of the changing scenario of cropping pattern, this study was undertaken to analyse the dynamic changes in the cropping pattern in Tamil Nadu, over 30 years from 1990 to 2020 and if was grouped and analysed as three decades as 1990-91 to 1999-2000, 2000-01 to 2009-10 and 2010-11 to 2019-2020.The analysis was done using only the secondary data. The results of the study revealed that there has been positive variation in the area under cultivation for crops such as pulses, fruits and vegetables, flowers, spices and plantation crops. Growth rate of area under pulses was positively significant in the overall period. The Markov analysis results revealed that cereals and oilseeds are highly stable and tuber crops and spices are highly unstable. There have been a gradual shift in the cropping pattern towards high value crops in Tamil Nadu. These variations of cropping performance of area under major crops was due to the physical, agroclimatic and socio-economic factors.

Keywords: Cropping pattern, Crop diversification, Growth rate, Markov chain, Stability.

INTRODUCTION

Agriculture is the mainstay of our country and it continues to be the most predominant sector of the economy in Tamil Nadu. Crop cultivation has been chosen by the farmers on the basis of the factors like physical, social and economic. Sometimes they cultivate a number of crops at their farms and rotate a particular crop combination over a period. Cropping pattern is a dynamic concept because it changes over space and time. It can be defined as the proportion of area under various crops at a point of time. The cropping patterns in India can be presented by taking the major crops into consideration as the base crop and all other possible alternative crops. Crop diversification implies cultivating a wide variety of crops in order to overcome the production and financial risks. Crop diversification in India is generally viewed as a shift from traditionally grown less remunerative crops to more remunerative crops. Crop diversification is intended to give a wider choice in the production of a variety of crops in a given area so as to expand production related activities on various crops and also to lessen risk. Due to diverse agro-climatic conditions in the country, a large number of agricultural items are produced. Broadly, these can be classified into two groups - foodgrains crops and commercial crops (Hazra, 2020). Transforming agriculture towards a more diversified cropping system is a viable pathway for improving diets, welfare, risk management and the resilience of rural households (Tesfaye and Tirivayi, 2019).

Problem Focus

Cropping pattern chosen for the cultivation is based on the physical and socio-economic factors and mainly based on agro-climatic factors, which causes an immense effect on the type of farming in any area. Apart from soil and climate conditions, the cropping pattern of a region would depend on the nature and availability of the inputs, such as irrigation, power, technology etc. The cropping pattern changes can have both positive as well as negative impact.And the changes in the cropping pattern occur periodically depending upon the market forces, also effects on different aspects of farming and farm economy through the variation in prices, income, size of holdings and input prices. Government is capable to influence the cropping pattern through its legislative and administrative measures. Subsidy on farm inputs such as seeds, fertilizers have resulted in record production of food grains. Provision of irrigation, knowledge dissemination, technology demonstrations etc. have induced farmers to adopt new crops or use better crop combinations. These factors of change in cropping pattern in the state have been undergoing changes over a period of time and this resulted in crop diversification. Keeping in view of the changing scenario of cropping pattern, this study was undertaken to analyse the dynamic changes in the cropping pattern in Tamil Nadu, over 30 years from 1990 to 2020 and if was grouped and analysed as three decades as 1990-91 to 1999-2000, 2000-01 to 2009-10 and 2010-11 to 2019-2020.

Objectives

The specific objectives of the study are

1. To study the changes and growth trend in the area under major crops in the study area.
2. To examine the dynamic changes in the cropping pattern of Tamil Nadu over the years.
3. To measure the diversification indices of major crops in the study area.

MATERIALS AND METHODS

Tamil Nadu is purposively selected for this study. The study is based on the secondary data regarding cropping pattern, i.e., area under major crop categories in Tamil Nadu. The data was obtained from Season and Crop Reports released every year by Directorate of Economics and Statistics, Government of Tamil Nadu for the period from 1990-91 to 2019-2020, which was disaggregated for three decades, i.e., Decade I (1990-91 to 1999-2000), Decade II (2000-01 to 2009-10) and Decade III (2010-11 to 2019-2020). The major crop categories considered for the study were cereals, pulses, oil seeds, tuber crops, fiber crops, cash crops, fruits & vegetables, flowers, spices and plantation crops.

Tools of Analysis

Growth Rate Analysis

The compound growth rates of area under major crop categories were estimated to capture the temporal changes in the cropping pattern. Exponential function of following form was used to estimate the growth rates

$Y_t=Y_o\ (1+r)^t$---------- (1)

Where,
Y_t = Area under the crop category at time t (ha)
r = Compound rate of growth of Y
Y_o = Initial year area under the crop category (ha)

By taking natural logarithm of (1),

$\ln Y_t = \ln Y_o + t \ln (1+r)$ ---------- (2)

Now letting,
$\beta_1 = \ln Y_o$
$\beta_2 = \ln (1+r)$

Equation (2) can be written as
$\ln Y_t = \beta_1 + \beta_2 t$---------- (3)

Adding the disturbance term to (3), it can be written as
$\ln Y_t = \beta_1 + \beta_{2t} t + U_i$
Y_t = Area under the crop category at time 't' (ha)
t = time in years
β_1 = constant term
β_2 = regression co-efficient

This log linear function was fitted by using Ordinary Least Square (OLS) method. The compound growth rate (r) was obtained using the formula.
r = (Antilog of β_2 - 1) × 100

Markov Chain Analysis

The dynamism in direction of area under crop categories were analyzed using the first order Markov chain approach using LINDO software. Central to Markov chain analysis is the estimation of the transitional probability matrix 'P', whose elements, P_{ij} indicate the probability (share) of crop categories switching from i^{th} crop category to j^{th} crop category over time. The diagonal element P_{ij}, where i=j represents the retention share of respective crop category in terms of area under crops. This can be denoted algebraically as

$E_{jt}= \sum_{i=1}^{n}(E_{it} - 1)P_{ij} + e_{jt}$

Where,

E_{jt} = Area under crop category to the j^{th} crop in the year t
E_{it-1} = Area under i^{th}cropcategory during the year t-1
P_{ij} = The probability of shift in area under i^{th} crop category to j^{th} crop category
e_{jt} = The error term which is statistically independent of $E_{i\,t-1}$
n = The number of crop categories

The transitional probabilities P_{ij}, which can be arranged in a (m x n) matrix, have the following properties:

$\sum_{i=1}^{n} P_{ij} = 1$ And $0 \leq P_{ij} \leq 1$

Thus, the expected share of each crop category during period 't' is obtained by multiplying the share of these crop categories in the previous period (t-1) with the transitional probability matrix. The transitional probability matrix is estimated using linear programming (LP) framework by a method referred to as minimization of Mean Absolute Deviation (MAD), the formulation is stated as

Min, OP* + I e
Subject to,
X P* + V = Y
GP* = 1
P* ≥ 0

Where,
P* is a vector of the transitional probabilities P_{ij} to be estimated
O is the vector of zeros
I is an appropriately dimensional vector of areas
e is the vector of absolute errors
Y is the proportion of area to each crop category.
X is a block diagonal matrix of lagged values of Y
V is the vector of errors
G is a grouping matrix to add the row elements of P arranged in P* to unity.

Diversification Indices
The following indices were used in the study to measure the extent of crop diversification.

Herfindahl Index (HI)
Herfindahl index is the sum of square of the acreage proportion of each crop in the total cropped area. The index is computed as

$HI = \sum_{i=1}^{N} P_i^2$, where, P_i represents acreage proportion of the i^{th} crop in total cropped area.

With an increase in diversification, the sum of square of the proportion of activities decreases, so also the indices. The Herfindahl Index takes the value one, when there is complete specialization and approaches to zero as N gets large, i.e., if diversification is perfect. Since the index is a measure of concentration, it was transformed by subtracting it from one, i.e., 1-HI. The transformed value of Herfindahl Index will avoid confusion to compare it with other indices. The major limitation of the index is that it cannot assume the theoretical minimum, i.e., zero for smaller values of N.

Simpson Index (SI)
The Simpson Index (SI) is the most suitable index of measuring diversification in a particular geographical region. Mathematically, SI is defined as

$SI = 1-\Sigma^{N}_{i=1} P_i^2$

Where,
$P_i = A_i / \Sigma A_i$ is the proportion of the i^{th} activity in acreage.

If Simpson Index is nearer to zero, it indicates that the zone or region is near to the specialization in growing of a particular crop and if it is close to one, then the zone is fully diversified in terms of crops.

Entropy Index (EI)

The Entropy index is a direct measure of diversification having a logarithmic character. The index is computed as: $EI = \sum_{i=1}^{N} P_i * \log (1/P_i)$, where, P_i represents acreage proportion of the i^{th} crop in total cropped area.

RESULTS AND DISCUSSION

Changes in Area under Major Crops in Tamil Nadu

The average area under major crop categories in Tamil Nadu over the periods from 1990-91 to 2019-2020 was worked out as three decades and is presented in Table 1 and it shows that the total area under major crops was decreased from decade I (60.60 per cent) to around 51 per cent in decade II & III. The cropping area of pulses, tuber crops, flowers, spices, fruits and vegetables and plantation crops had increased in decade III when compared to decade I. The cropping performance of cereals, oilseeds, fiber crops, cash crops and spices had been decreased from decade I to decade III, but around 50 per cent of area was occupied by cereals in all the three decades. The percentage change in the total area under different crops from decade I to decade III was decreased to 15 per cent and there has been a positive changes in the area under cultivation for crops, such as pulses, fruits and vegetables, flowers, spices and plantation crops.

Growth Rate of Area under Major Crop Categories

The growth in the area under major crop categories in Tamil Nadu over a period of 30 years (1990-91 to 2019-2020) and a disaggregated analysis for the three decades was done using the compound growth rate analysis. From the Table 2, it could be seen that the growth rate of cereals and pulses were negative Decade I & II and it had been turned out to be 1.28 per cent and 3.67 per cent respectively, in Decade III. During Decade I, the growth rate of area under cash crops was positively significant (3.53 per cent) and oilseeds was negatively significant (3.86 per cent) whereas in Decade II, the growth rate of fruits and vegetables were positively significant (2.29 per cent) and spices was negatively significant (2.10 per cent). And in Decade III, the area under plantation crops have shown positively significant with 0.29 per cent and negatively significant at 3.64 per cent of tuber crops. During the overall period, the growth in the area under pulses (1.03 per cent) was positively significant in Tamil Nadu. In contrast, the growth in the area under cereals (0.68 per cent) and fiber crops (2.90 per cent) was negatively significant and oilseeds, cash crops and spices have also decreased by 4.93 per cent, 0.83 per cent, 1.10 per cent, respectively. While the growth rates in the area under tuber crops (0.15 per cent), fruits and vegetables (2.03 per cent), flowers (5.01 per cent) and plantation crops (2.62 per cent) were positive.

Dynamic Changes in the Area under Major Crop Categories in Tamil Nadu

The direction of changes in the area under major crop categories in Tamil Nadu was analysed and results of Markov chain model are presented in Table 3. It could be revealed from Table 3, that the diagonal elements represent the probability of retention of existing area under different crops. For instance, the probability of retention of existing area under cereals was estimated at 76 per cent. But the probability of shift in area from cereals was 6.30 per cent to plantation crops, 6.24 percent to fruits and vegetables, 4.88 per cent to pulses, 3.90 percent to tuber crops and 2.38 per cent to fiber crops. However, it gained around 87 per cent from pulses, 60 per cent from spices, 48 per cent from fiber crops and 3 per cent from oilseeds. From the Table 3, it is also observed that pulses and plantation crops have less probability of retention, i.e., around 10 per cent and also it could be seen that zero probability of retention occurred for crops such as tuber crops, cash crops, fruits and vegetables and spices. The estimated steady state probability reveals that if the cropping pattern continues in the future, around 52 per cent of area will be under cereals, around 11 per cent under pulses and plantation crops, each 7 per cent under fruits and vegetables, around 4 per cent under oilseeds and cash crops, 3 per cent under fiber crops, 2 per cent under tuber crops, one per cent under spices and 0.85 per cent under flowers. The results revealed that cereals and oilseeds are highly stable in the study area (73 per cent)

and highly unstable crops are tuber crops and spices, which has no probability of retention and less steady state probability.

Crop Diversification Indices for Area under Major Crop Categories

Crop diversification based on proportion of area under major crop categories is measured and quantified using Herfindhal Index (HI), Simpson Index (SI) and Entropy Index (EI) for the three decadal periods. The average values of these indices for different crop categories in the study area are presented in Table 4. The Herfindahl index would decrease with increase in diversification. It could be seen from Table 4 that the calculated average values of Herfindahl Index for major crop categories decreased in Tamil Nadu over the three decadal periods, from 1990-91 to 2019-2020, i.e., from 0.2965 in Decade I to 0.2886 in Decade III, implying marginal crop diversification over the period of study. The Simpson index would increase with the increase in diversification and vice versa. The results revealed that the calculated average values of Simpson Index moved up from 0.7035 in Decade I to 0.7114 Decade III in Tamil Nadu and shows slight diversification. The Entropy index increases with increase in diversification and vice-versa. The entropy index of crop diversification on the proportion of area under major crops in Tamil Nadu during Decade I to Decade III, clearly revealed that this index of crop diversification varied from 1.5923 to 1.6635, indicating increased diversification in Tamil Nadu over the three decadal periods. From the above results, it is evident that there have been a gradual shift in the cropping pattern towards high value crops in Tamil Nadu. This might be due to the availability of market, increased demand of products and export facilities.

CONCLUSION

In Tamil Nadu, the area under major crop categories had changed its cropping pattern in past three decades. Even though cereals plays a major role in food grain production, the cultivation of cereals have been decreased over the three decades but around 50 per cent of area was occupied by cereals in the total area. From this study, it is concluded that there is positive variation for cropping pattern of crops such as pulses, fruits and vegetables, flowers, spices and plantation crops. Growth rate of area under pulses was positively significant in the overall period. The Markov analysis results revealed that cereals and oilseeds are highly stable and tuber crops and spices are highly unstable in the study area. Also, there have been a gradual shift in the cropping pattern towards high value crops in Tamil Nadu. These variations of cropping performance of area under major crops might be due to the physical, agroclimatic and socio-economic factors.

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Table 1. Changes in the Average Area Under Crop Categories in Tamil Nadu (in lakh hectares)

S. No	Major Crop Categories	Decade I	Decade II		Decade III	
		1990-91 to 1999-2000	2000-01 to 2009-2010	Percentage Change over 1990-99	2010-11 to 2019-2020	Percentage Change over 1990-99
1.	Cereals	29.82 (49.21)	25.37 (49.45)	-17.54	25.57 (49.68)	-14.23
2.	Pulses	5.33 (8.80)	4.96 (9.66)	-7.58	6.72 (13.05)	26.02
3.	Oilseeds	11.62 (19.18)	6.63 (12.93)	-75.22	4.02 (7.80)	-65.43
4.	Tuber crops	0.90 (1.48)	1.18 (2.31)	24.33	0.92 (1.79)	2.77
5.	Fiber crops	3.29 (5.42)	1.16 (2.27)	-182.11	1.51 (2.93)	-54.05
7.	Cash crops	2.84 (4.69)	3.06 (5.96)	7.08	2.56 (4.98)	-9.86
8.	Fruits and Vegetables	2.22 (3.66)	2.88 (5.62)	23.13	3.21 (6.23)	44.78
10.	Flowers	0.14 (0.24)	0.25 (0.48)	42.01	0.39 (0.77)	175.72
11.	Spices	1.30 (2.14)	1.13 (2.20)	-15.03	1.31 (2.55)	0.91
12.	Plantation crops	3.15 (5.19)	4.68 (9.12)	32.72	5.26 (10.22)	67.11
	Total	**60.60 (100.00)**	**51.30 (100.00)**	**-18.12**	**51.47 (100.00)**	**-15.06**

(Note: Figures in the parentheses are percentage to total)

Table 2. Growth Rates of Area Under Major Crop Categories in Tamil Nadu

S. No.	Crop Categories	Decade I	Decade II	Decade III	Overall period
1.	Cereals	-0.68	-0.05	1.28	-0.68***
2.	Pulses	-2.43	-0.87	3.67	1.03***
3.	Oilseeds	-3.86***	-4.07	-1.59	-4.93
4.	Tuber crops	1.04	4.06	-3.64***	0.15
5.	Fiber crops	-6.39	-3.37	2.62	-2.90***
6.	Cash crops	3.53**	1.81	-10.16	-0.83
7.	Fruits and Vegetables	5.91	2.29***	0.34	2.03
8.	Flowers	6.10	5.72	-0.35	5.01
9.	Spices	1.87	-2.10**	-6.62	-1.10
10.	Plantation crops	4.97	2.02	0.29***	2.62

(** and *** indicate significance at 5 per cent and 1 per cent levels respectively)

Table 3. Transitional Probability Matrix for Area under Major Crop Categories in Tamil Nadu, 1990-91 to 2019-2020

Major Crops Categories	Cereals	Pulses	Oilseeds	Tuber crops	Fiber crops	Cash crops	Fruits and Vegetables	Flowers	Spices	Plantation Crops
Cereals	0.7629	0.0488	0.0000	0.0390	0.0238	0.0000	0.0624	0.0000	0.0000	0.0630
Pulses	0.8797	0.1084	0.0000	0.0000	0.0119	0.0000	0.0000	0.0000	0.0000	0.0000
Oilseeds	0.0338	0.0000	0.7355	0.0000	0.0000	0.1596	0.0000	0.0000	0.0711	0.0000
Tuber crops	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000
Fiber crops	0.4893	0.0000	0.3080	0.0000	0.2027	0.0000	0.0000	0.0000	0.0000	0.0000

Cash crops	0.0000	0.8044	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1956	0.0000
Fruits and Vegetables	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
Flowers	0.0000	0.8470	0.0000	0.0000	0.0000	0.0000	0.0000	0.1530	0.0000	0.0000
Spices	0.6079	0.2361	0.1559	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Plantation crops	0.0000	0.2387	0.0000	0.0000	0.1173	0.1491	0.3239	0.0612	0.0000	0.1098
Steady State Probability	**0.5291**	**0.1130**	**0.0477**	**0.0207**	**0.0347**	**0.0458**	**0.0710**	**0.0085**	**0.0123**	**0.1172**

Table 4. Crop Diversification Indices for Area under Major Crop Categories in Tamil Nadu

S. No	Year	Herfindahl Index	Simpson Index	Entropy Index
1.	Decade I (1990-1991 to 1999-2000)	0.2965	0.7035	1.5923
2.	Decade II (2000-2001 to 2009-2010)	0.2872	0.7128	1.666
3.	Decade III (2010-2011 to 2019-2020)	0.2886	0.7114	1.6635
	Overall Periods	0.2877	0.7123	1.6426

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RESEARCH ARTICLE

Emotional Maturity and Identity among Adult Students

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ABSTRACT

Emotional Maturity is considered as an important aspect for adjustment in adulthood. Early adulthood is also a period of adjustments to new patterns of life and new social expectations. The young adult is expected to play new roles and to develop new attitudes in emotional maturity, interests, identities and values according to new rules. The present study was designed to examine the relationship and the level of emotional maturity and identity among young adult students. Using the structured questionnaire, the data was collected from 120 students aged 21 to 24 from Karnatak University, Dharwad, Karnataka, India. Prof. Yeshver Singh & Prof. Mahesh Bhargave (1990) Emotional maturity scale and Cheek and Brigg's (1981, 1982)Identity scale were adopted to collect the data. The respondents were divided on the basis of gender and stream. The 't' test, and Pearson's Correlation Coefficient (r) were used for statistical analysis to examine the gender difference and the relationship between the groups. Findings of the study revealed that boys have significantly higher emotional maturity compared to girls in dimension wise as well as overall emotional maturity and there is no significant difference found in identity variable; science stream students have significantly higher emotional maturity and identity in comparison with social science stream students. Findings also revealed that emotional maturity is negatively and highly significantly related to personal identity, relational identity; negatively and significantly related with collective identity among young adult boys; no significant gender difference was found between emotional maturity and identity.

Keywords: Emotional Maturity, Identity, Young Adult Students, Science and Social Science Stream

INTRODUCTION

Emotional maturity refers to the ability for comprehension, and management of emotions. It helps to create a mentally healthy individual in personal as well as in social life. Emotional maturity can also be defined as, "the capacity of an adult to maintain emotions which include emotional progression, independence, social adjustment, emotional stability, personality integration,". when we think of any person who is emotionally mature, we tend to expect more understanding and acceptability from that person. An individual who could sustain stress and go through the difficult times calmly with the sense of wisdom, like initiating responsibilities, owning ones own wrong doings, showing empathy, accepting changes that fall unexpectedly. According to Yashvir Singh and Mahesh Bhargava (1990)[1] emotional immaturity includes emotional instability and it is basically individuals lack of skills in solving problems and they always want help from others they seem to be more stubborn. The second area is all about emotional regression; it includes feeling of inferiority, hostility, self-centeredness, etc. The third area is social adjustment, individuals who have social maladjustment will be having lack of social adaptability and have hatred, they seem to be exclusive but always boasting, they are mostly identified as liars. The fourth area is personality integration, where those who possess personality disintegration will be showing fears, phobias, etc. independence is the fifth area, where those who lack independence, seem to be showing more dependence, where, they will be extremely dependent on others. Identity is unique to each of us that we assume is more or less consistent over time, our identity is something we uniquely possess that is what distinguishes us from other people. Yet on the other hand, identity also implies a relationship with a broader collective or social group of some kind. Here, identity is about identification with others whom we assume are similar to us (if not exactly the same), at least in some significant ways.

Identity process—and indeed a function of general cognitive development—it also occurs through interaction with peers and care givers. Identity is developed by the individual, but it has to be recognized and confirmed by others. Cote & Levine, 2002; Kleiber,1999 [2]. states identity as, a sense of inner wholeness…between childhood and anticipated future; between which he conceives himself to be and perceives others to see and expect from him. According to Cheek and Brigg's (1981, 1982) [3]. Personal Identity what does being the person that you are, from one day to the next, necessarily consist in? This is the question of personal identity, and it is literally a question of life and death, as the correct answer to it determines which type of changes a person can undergo without ceasing to exist. Personal identity of our own existence. Relational Identity as the nature of one's role relationship. Indeed, it is relational identities that knit the network of roles together into social system. And the relational identity, of course, draws on the interpersonal level, may be a result of the fact that they don't need others for affirmation or validation. Social identity is a person's sense of who they are, based on their group membership. TAJFEL (1985,1986) [4] proposed that the groups (Social class, family) which people belonged to were an important source of pride and self-esteem. Groups gave us a sense of belonging to social identity; a sense of belonging to the social world. In order to enhance the status of the group to which we belong. Therefore, based through the process of social categorization the world was divided into them and us. This is known as in group – us and out group –them. Collective identity has been at the centre of attention in societies that have been formed in the course of the making of the nation-state. Collective Identities are collective rationalizations of social relations. The link between identity and reality is to be constructed independently from psychological assumptions about human needs or motivations for collective identity. Collective identities are social constructions which make use of psychological needs and motives for providing an answer to the question „whom do I belong to" or to the question „whom do we belong to?" This happens in social relations bound to social interaction.

Adults with a clear sense of self and identity or with idealised identity tends to be better in identifying their underlying potentials and talent along with taking their own decisions independently without getting influenced by others opinion which ultimately helps them to excel in every field such as academics, extracurricular and various other co-curricular activities and accordingly, adult students give efforts in their area of interest without never getting diverted from their goals Sharma (2012) [5]. Hamburg A, Hamburg A (2004) [6] states that Emotional

maturity incorporates the significant aspects of interpersonal and intrapersonal relationships, adaptability, feelings and skills to manage stress, which have a profound effect on the academic performance of students. An individual ability to endure through various challenges and hardships as well as to deal efficiently with various emotional turmoil during this period determines their future identity. Thus, overall, it can be concluded that identity and emotional maturity plays an important role in life and are highly interrelated with each other. Emotional maturity and identity are interdependent because of the fact that until and unless the individual is aware of the society, where he or she lives in, will surely crave the identity that one should have, related to their personal growth, being emotionally matured aids the freedom of thinking about the independency which will in turn focus on being in solitude to achieve success in all the areas of life. Emotional maturity will help us to create a sense of self-worth which is helpful in recognising the different types of identities. As limited Indian researches have been done so far related to this aspect hence, present study is an attempt to assess emotional maturity and identity.

METHODS

Sample

A total of 120 young adult students between the age of 21 to 24 years were selected through random sampling procedure which was divided into science and social science streams constituting 60 boy and 60 girlyoung adult students.

MEASURES USED FOR THE STUDY

Emotional Maturity Scale

The emotional maturity scale is a 48 items scale developed by Prof. Yeshver Singh & Prof. Mahesh Bhargave (1990)[1] was used to measure five dimensions emotional instability, emotional regression, social maladjustment, personality disintegration and lack of independence, the respondent should answer each item on five-point Likert scale ranging from 5 (very much) to 1 (never) higher the score higher is the emotional maturity. The authors have reported high validity and reliability for the scale.

Identity Scale

The Identity scale is a 45 items scale developed by Cheek and Brigg's. (1981, 1982) [3] was used to measure 4 dimensions personal Identity, relational identity, social identity, collective identity 1 to 5; not important=1, extremely important=5. Higher the score higher the identity. The authors have reported high validity and reliability for the scale.

Statistical Analysis

1. Independent sample 't' test
2. Pearson's correlation coefficient

Objectives

This study was mainly undertaken with objective to assess the gender difference and stream differences between emotional maturity and identity among young adult students and also to study the relationship between emotional maturity and identity among young adults.

Hypotheses

The following hypotheses were formulated to achieve the objectives of the study

Ha 1: There is a significant gender difference in emotional maturity

Ha 2: There is significant gender difference in identity

Ha 3: There is significant difference in emotional maturity among social science and science stream students

Ha 4: There is significant difference in identity among social science and science stream students

Ha 5: Emotional maturity is significantly and positively related with identity among boys

Ha 6: Emotional maturity is significantly and positively related with identity among girls

RESULT AND DISCUSSION

Glance at Table 1 shows that there is significant difference between boys and girls in the dimension of emotional instability (t = 3.22**, <0.01), social maladjustment (t = 3.07**, <0.01) as well as in overall (t = 2.25**, <0.01) Emotional Maturity Boys have scored significantly higher on dimension of emotional instability, social maladjustment and overall Emotional Maturity, when compared to girls. This may be due to the reason that, because of socialisation and the gender role expectations, boys develop the capacity to tackle the problems and tolerate a reasonable number of frustrations which leads to autonomy, confidence and whereas girls are restricted and remained within the family. The results are in tune with the findings obtained by Kaur and Singh (2016)[7], Aleem (2005)[8], Bhattacharjee (2016)[9], Lal (2014)[10], Nuzhat (2013) [11], Rani and Kumari (2014)[12].However, no significant gender difference is found in the dimension of emotional regression, personality disintegration and lack of independence. An observation of Table 2 shows that there is no significant difference found between boys and girls in any dimensions of identity. This may be due to the fact that as the modernization progresses the factors like traditional values, low mobility, lack of confidence, gender stereotypes which were responsible for creating gender disparity have reduced and given way for equal opportunities in the society to create their self-identity.

Table 3 explicitly reveals that, there is a significant difference between social science and science stream students on the dimension of emotional instability, social maladjustment and overall emotional maturity. The students from science stream have scored significantly higher on emotional instability, social maladjustment and overall maturity compared to social science students (t = 3.32***, < 0.001).This present finding may be interpreted by the type of education, facilities and opportunities in the science stream enhances student's self-confidence and in turn positively impacts the development of emotional maturity. However, no significant difference was found in emotional regression, personality disintegration and lack of independence among social science and science stream students. It is clear from Table 4 that there is significant difference between social science and science stream students on collective identity (t = 2.36*,<0.05).The science students have scored significantly higher on collective identity compared to their counterparts. However, no significant difference was found on personal identity, relational identity and social identity among social science and science stream students. An observation of Table 5showsthat emotional maturity is negatively and highly significantly correlated with personal identity and relational identity (r = -.33**,-.34**, <0.01)and negatively and significantly linked with collective identity (r = -.26*,<0.05)among adult boys. This present findings is in agreement with the findings obtained byS Behera (2017)[13]. An observation of table 6 shows that, emotional maturity of adult girls is not correlated with any of the dimensions of identity. The present findings can be interpretated as girls play the role of caretakersare emotionally matured and less intended in showcasing the type of identity which they possess.

CONCLUSIONS

1. Boys have significantly higher emotional maturity when compared to girls
2. No significant difference was found in the identity of boys and girls.
3. Science stream students have significantly higher emotional maturity when compared to social science stream students
4. Science stream students have significantly higher identity when compared to social science stream.
5. Emotional maturity is significantly and positively related with identity among boys
6: Emotional maturity is negatively insignificantly related with identity among girls

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Table 1: Showing Mean, Standard Deviation and 't' value for Emotional Maturity of Adult Boys & Girls (Dimension wise and overall score)

Dimensions	Boys (N= 60)		Girls (N=60)		t value
	M	SD	M	SD	
Emotional Instability	52.88	10.95	47.25	7.95	3.22**
Emotional Regression	51.33	10.10	48.72	9.80	1.43
Social Maladjustment	52.68	9.61	47.25	9.73	3.07**
Personality Disintegration	50.12	9.92	49.92	10.16	.10
Lack of Independence	51.53	9.01	48.47	10.79	1.68
Total	52.12	9.01	48.07	9.94	2.25**

**P <0.01; highly significant

Table 2: Showing Mean, Standard Deviation and 't' value for Identity of Adult Girls & Boys

Dimensions	Boys (N=60)		Girls (N=60)		t value
	M	SD	M	SD	
Personal Identity	49.70	10.24	50.35	9.97	.35
Relational Identity	50.22	10.38	49.78	9.72	.23
Social Identity	50.20	8.79	50.05	11.13	.08
Collective Identity	50.62	9.06	49.35	10.95	.69

Table 3: Showing Mean, Standard Deviation and 't' value for Emotional Maturity of Social Science and Science stream Adult students

Dimensions	Social science (N=71)		Science (N= 49)		t value
	M	SD	M	SD	
Emotional Instability	47.66	8.48	53.55	10.92	3.32***
Emotional Regression	49.46	9.86	50.84	10.24	.73
Social Maladjustment	48.11	9.98	52.65	9.51	2.49**
Personality Disintegration	49.69	9.90	50.49	10.22	.42
Lack of Independence	48.63	10.02	51.98	9.79	1.81
Total	48.54	9.72	52.35	10.09	2.06*

***P< 0.001; very highly significant

**P<0.01; highly significant

*P<0.05;significant

Table 4: **Showing Mean, Standard Deviation and 't' value for Identity of Social Science and Science stream, Students**

Dimensions	Social science (N=71)		Science (N=49)		t value
	M	SD	M	SD	
Personal Identity	49.42	9.60	50.90	10.75	.78
Relational Identity	49.11	9.63	51.29	10.51	1.17
Social Identity	49.63	9.72	50.84	10.42	.64
Collective Identity	48.23	9.89	52.53	9.77	2.36*

*P<0.05; significant

Table 5: Showing the Pearson's Correlation Coefficient between Emotional Maturity and Identity among Adult boys

Variable	Personal Identity	Relational Identity	Social Identity	Collective Identity
Emotional Maturity	-.33**	-.34**	.03	-.26*

**P<0.01; highly significant

*P<0.05; Significant

Table 6: Showing the Pearson Correlation Coefficient between Emotional Maturity and Identity of Adult girls

Dimensions	Personal Identity	Relational Identity	Social Identity	Collective Identity
Emotional Maturity	-.17	-.22	-.02	.08

RESEARCH ARTICLE

Biological Degradation of Textile Dye Effluent through Indigenous Bacteria

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ABSTRACT

Textile industries discharge a huge amount of effluent containing various harmful chemicals including synthetic dyes that are very stable and threat to the living organisms. This study deals with the potential decolorization and biodegradation of Reactive Blue –M58 ,Reactive Yellow – M4G and Reactive Black - dyes using bacteria isolated from textile effluent. The effluent samples were collected from different locations of discharge point. Only two isolates were screened out after primary screening using dye supplemented nutrient agar media. Following colony morphology, physiology and biochemical analysis, they were tentatively identified as *Bacillus sp*. and *Staphylococcus aureus.* They were subjected to decolorization of 0.002 g/l Reactive Blue –M58 ,Reactive Yellow – M4G and Reactive Black - dyes. Staphylococcus aureus sp. showed superior decolorization potential of Reactive yellow (90%) followed by Reactive red (80%) dyes after 5 days of incubation. Whereas, *Bacillus sp* showed 83% decolorization of Reactive Yellow dye after 5 days incubation. Decolorization efficacy can be further improved by optimizing environmental conditions and process parameters.

Keywords: Effluent, Textile dye, Biodegradation, Decolorization.

INTRODUCTION

Rapid industrialization and urbanization lead to continuous deterioration of the eco system. Textile, printing, food and cosmetics industries are the largest source of dye containing effluent that on discharge generates serious environmental threats [Dawkar, *et al.,* 2008]. Significant problems arise from the high levels of production and low levels of recycling of these pollutants from textile industries [Fatima *et al.,*2015]. The colored effluent discharged by

these industries contain toxic organic residues including mixture of chemically versatile dyes leads to the serious pollution of surface water, ground waters and soil [Shaker, *et al .*,2014]. Dyes are usually aromatic and heterocyclic compounds and are often recalcitrant, some of them being toxic and even carcinogenic. These dyes include several structural varieties such as acid, reactive, basic, disperse, azo, diazo, anthraquinone based and metal complex dyes. Azo dyes comprise a diverse group of synthetic chemicals that are widely used by the leather, textile, cosmetics and paper product industries [Kalyani *et al* 2008]. Their pollution potential seems from their possible toxicity and carcinogenicity which is mainly due to components such as benzidine and other aromatic compounds, however dyes are more difficult to treat because of their synthetic origin and mainly complex aromatic molecular structures [Hassan *et al* 2013]. Such structures are often constructed to resist fading on exposure to sweat, soap, water, light or oxidizing agents and this renders them more stable and less amenable to biodegradation [Hassan *et al* 2013Gohel*etal*2018]. Inefficiency of the dyeing processes, poor handling of spent effluent and insufficient treatment of wastes of the dyestuff industries lead to dye contamination of the environment such as soil and natural water bodies [Robinson*et al .*,2001]. Many physical and chemical methods have been employed for decolorization and degradation of dyes but these methods have limitations such as high running cost and disposal of large amount of sludge produced during these processes [Zhang,*et al.*,2004].

On the contrary, biological methods are extensively been used which offers several advantages such as cheap, simple, produce smaller volumes of sludge and high flexibility [Chen, *et al* 2003]. Many bacteria belonging to genera Bacillus, Micrococcus, Proteus, Pseudomonas, Sphingomonas and Staphylococcus [Dave, and Dave 2008, fungi and algae [, Ghanem *et al* 2011] are employed for biotreatment of textile dyes under aerobic and anaerobic conditions. The most promising microorganisms for dye wastewater treatment are those isolated from sites contaminated with dyes (indigenous) because they have adapted to survive in adverse conditions [Myrna,*et al* 2012]. A potential low-cost alternative method used for color removal from textile effluent is biosorption [Fan, *et al .*,2009]. This process utilizes the recalcitrance of dyes and affinity to adhere to surfaces as means of removing them through adsorption on biomass De Angelis, and Rodrigues, 1987, Nawar, and Doma, 1989.]. Strong biosorption behavior of certain types of microbial biomass toward metallic ions and other pollutants, such as textile dyes, is a function of the chemical makeup of the microbial cells of which the biomass consists. Several workers [White, C. and Gadd1997., White, *et al.*,1995] described that chemical groups like acetamide group of chitin, phosphate groups in nucleic acids, amino, amido, sulfhydryl, carboxyl groups in proteins and hydroxyl in polysaccharides in biomass could attract and sequester charged pollutants. Bacteria and fungi along with their enzymes such as lignin- degrading enzyme and exopolymeric substances are used for decolorization of effluents under controlled conditions. The present study deals with the isolation, morphological and biochemical identification of indigenous bacteria and evaluation of ability of selected bacteria to decolorize dyes.

MATERIALS AND METHODS

Chemicals and Media

Textile dyes namely Dyes: Reactive azo dyes used in this research are, Reactive Orange – M2R (m = 493 nm), Reactive Blue –M58 (m = 572 nm), Reactive Yellow – M4G (m = 413 nm) and Reactive Black - B (m = 574 nm).were collected directly from a textile industry located in Erode, Bhuvanagiri and Kumbakonam Tamil Nadu India. The chemicals used in this work were of analytical grade. Microbiological media and medium ingredients were purchased from Himedia Mumbai.

Sample collection

The dye effluents were collected from three different dying industries in Erode ,Bhuvanagiri and Kumbakonam, Tamil Nadu, India. The samples were named as, S1, S2 and S3 respectively, based on their place name. The effluent samples were collected in plastic cans, collected the cans was rinsed tap water and distilled water and transported to the laboratory and stored at 4°C .

Physico-chemical property analysis

The collected effluent samples have been analyzed to determine its physico-chemical parameters. The various parameters viz., Temperature, pH, Electrical Conductivity (EC), Colour, Odour, Total dissolved solid (TDS), Total suspended solids (TSS), Chemical oxygen demand (COD), Biological oxygen demand (BOD), Dissolved Oxygen (DO), Total Hardness, Chloride, Ca Hardness and Mg Hardness were analysed in the laboratory by the standard protocol.

Screening and isolation of dye decolorizing bacteria.

Before inoculation into solid media, the collected samples were enriched by inoculating 500 µl of samples into 10 ml of nutrient broth supplemented with 0.002 g/l Reactive Blue –M58 ,Reactive Yellow – M4G and Reactive Black - dyes at room temperature for 24 h under shaking conditions (120 rpm). Following enrichment, samples were diluted and 100 µl of diluted enriched samples were spread on nutrient agar media supplemented with 0.002 g/l l Reactive Blue – M58 ,Reactive Yellow – M4G and Reactive Black dyes. The plates were incubated at 37°C for 48 h to detect bacteria that can withstand the selected dye concentration. Morphologically distinct bacterial isolates were distinguished for further study and pure culture of those isolates was cultured on nutrient agar media for storage at 4°C(8).

Identification of selected bacterial isolates.

The isolated bacteria were subjected to Gram staining, morphological and biochemical characterization as described by the Bergey's Manual of Determinative Bacteriology, 8th edition. The tests performed were IMViC, starch hydrolysis, catalase, oxidase, H_2S production, fermentation of lactose, dextrose and sucrose.

Dye decolorization assay

Decolorization experiment of those three selected dyes was performed by using 0.002 g/l of dye in 15 ml test tubes containing 10 ml of nutrient broth. A 100 µl of 24 h old bacterial culture corresponding to Mcfarl and standard 0.5 was used as inoculum to inoculate the dye supplemented broth. The inoculated test tubes were incubated at 37°C for 1, 3 and 5 days to check the absorbance. Following incubation, decolorization of dyes by selected isolates was determined at their specific maximum wavelength in the culture supernatant using a UV-spectrophotometer. After incubation at each time period, samples were centrifuged at 10,000 rpm for 10 min and the supernatants were subjected to UV-spectrometry and the absorbance was recorded. The uninoculated media with Reactive Blue –M58 ,Reactive Yellow – M4G and Reactive Black dyes were used as respective blank for the dye decolorization assay. The percentage of dye decolorization was calculated as stated before (15).

$$\text{Decolorization (\%)} = \frac{\text{(Initial OD-Final OD)}}{\text{Initial OD}} \times 100$$

RESULTS AND DISCUSSION

Physico –chemical analysis of textile dye effluents

Textile dye industrial effluents are one of major sources of environmental toxicity. It not only affects the quality of drinking water but also has deleterious impact on the soil microflora and aquatic ecosystems. Soil is the most favourable habitat for a wide range of microorganisms that includes bacteria, fungi, algae, viruses and protozoa. Industries keeps on releasing effluents which is quite toxic whether its sugar mill or fertilizer industries, or chemical treatment given to the fields also cause problems for the survival of the soil micro flora [Thoker Farook Ahmed *et al.*,2012]. The dye effluents were collected from three dying industries in Bhuvanagiri, Kumbakonam and Erode in Tamil Nadu, India. These industries discharge the Blackish blue coloured effluents with dyes and toxic compounds into the open environment. It was found that all the dyeing industry is among those which contribute to water and soil pollution [Sriram, *et al* 2013]. Therefore, the collected sample have been analyzed to determine their physico – chemical characteristics of the dye effluents and recommended level of NEQS was showed Table – 1. Temperature range recorded the three effluents between 35°C to 45°C. The temperature high in recommended level [Manikandan, *et al* 2012]. The maximum pH range was recorded S2 (9.2) followed by S3 (8.6) and S1 (7.9). The pH was alkaline in

nature and samples have pH within the permissible limit also reported (Sofia Nosheen *et al.* (2010),electrical conductivity were recorded at S2 (248 µS/cm) followed by S3 (237 µS/cm) and S1 (223 µS/cm) which was also recommended of NEQS level. In the present study, the dye effluents have different dark colours and unpleasant odour [Manikandan, *et al* 2012]. The maximum values of total dissolved solid were obtained from S2 (2398 mg/l) followed by S3 (2215 mg/l) and S1 (2189 mg/l) respectively. High concentration of dissolved solids affects the density of water and influences solubility of gases in water (like oxygen) and osmoregulation of freshwater organisms [Sofia Nosheen *et al*.,2000]. [Thoker Farook Ahmed *et al*.,20122]; Arminder Kaur *et al*., (2010)also reported the TSS in textile dye effluent. The minimum total suspended solids were recorded at S1 (128 mg/l) while the maximum at S2 (179 mg/l) followed by S3 (154 mg/l). The maximum chemical oxygen demand were observed from S2 (856 mg/l) followed by S3 (837mg/l) and S1 (763 mg/l) which was much higher than maximum recommended limit of FEQS, it's impacted the receiving water body to some extent and its effects on the quality of freshwater and subsequently cause harm to aquatic life [Manikandan, *et al* 2012 [Sofia Nosheen *et al*.,2000]].

The maximum biological oxygen demand were observed from S2 (213 mg/l) followed by S3 (210 mg/l) and S1 (178 mg/l) was recorded and its shows high level of BOD present in effluents, which above the recommended level [Arminder Kaur, *et al* 2010]. Dissolved oxygen is a fundamental requirement for aquatic life [[Sofia Nosheen *et al*.,2000]]. The maximum dissolved oxygen were recorded at S2 (159 mg/l) followed by S3 (146 mg/l) and S1 (117 mg/l). The effluent waste discharge to surface water source is largely determined by oxygen balance of the system also recorded (Thoker Farook Ahmed *et al*. [2010]; Manikandan *et al*. 2012). Total Hardness is the property of water which prevents the lather formation with soap and increases the boiling point of water. Hardness of water mainly depends upon the amount of calcium and magnesium salts and chloride [Thoker Farook Ahmed *et al*.,2012]. The maximum hardness were recorded from S2 (320 mg/l) followed by S3 (306 mg/l) and S1 (293 mg/l). The maximum Chloride concentration was observed in S2 (1257 mg/l) as compared to other parameters like Ca (223 mg/l) and Mg (70.12 mg/l) in S2. The minimum values of chloride, Ca and Mg recorded in other two samples like S1 (1124 mg/l), (188 mg/l) and (56.96 mg/l) and S3 (1177 mg/l), (197 mg/l) and (65.83 mg/l) respectively, the Chloride occurs in all natural waters in widely varying concentrations. Excessive chloride in potable water is not particularly harmful microflora of aquatic life [Rajeswari *et al*.,2012].

Isolation of dye degrading bacteria.

Different effluents and soil samples from a discharge of textile industries located in erode district ,Tamil Nadu were collected to isolate dye degrading organisms. Only two isolates were found to grow profusely in all the three dye supplemented nutrient agarplates. During screening, only two bacterial isolates were identified from those 0.002g/ldye supplemented nutrient agarplates. The isolates showed distinct morphological characteristics on the dye supplemented nutrient agar media. Subsequently, the isolates were subjected to morphological, physiological and biochemical characterizations. The microscopic features, colony characteristics on nutrient agar media and biochemical characters are shown in Table 2, Table 3 and Table 4 According to colony morphology, physiology and biochemical characterization, those isolates were tentatively identified as *Bacillus sp.* and Staphylococcus aureus. Between the two isolates, Bacillus sp. is commonly found to degrade various textile dyes isolated from effluents of textile and printing press industries (Mahbub *et al* 2012, Prasad *et al* ., 2013).

Decolorization potential of the isolates

In the present study selected isolates were tested independently for their ability to decolorize 0.002g/l of the three textile dyes. The experiment was performed in a time-dependent manner for 1,3 and 5 days Decolorization percentage of the dyes with *Bacillus* sp. was shown in Figure 1. It was able to decolorize 53-83% of all dyes tested. Decolorization of Reactive yellow, Reactive red and Reactive black dyes was observed in a time-dependent manner. After 5 days incubation Reactive yellow, Reactive red and Reactive black dyes showed nearly 83%, 72% and 68% decolorization, respectively. Decolorization percentage by *Staphylococcus aureusis* presented in Figure2. Here, *S.aureus* time - dependently induced dye decolorization from approximately 49% to 90% for Reactive yellow dye , 60% to 74 for Reactive reddye and 38% to 52% for Reactive black dye. Isolate *Staphylococcus aureus* showed increased dye decolorization ability than *Bacillus* sp in the given environmental conditions. Percentage of

decolorization of Reactive yellow dye by Isolate Staphylococcus aureus was found to be the highest and that was nearly 90% after 5 days. For Bacillus the highest decolorization was observed for Reactive yellow dye and that was 83% following 5 days of incubation. Similar results we also obtained in our present study. The best Textile decolourizer of Direct Green-PLS was *Bacillus subtilis* (99.05%). *Klebsiella pneumoniae* (87.27%) highly decolourized the Direct Violet-BL. *Escherichia coli* (61.56%) was the best decolourizer of Direct Sky Blue-FF. The best decolourizer of Direct Black-E was *Klebsiella pneumoniae* (92.03%). Recently, Silveira *et al.*2014] checked the ability of *Pseudomonas sp*. to remove colour by Pseudomonas cepacia exhibited no growth at all on the plates containing dyes. whereas *Pseudomonas aeruginosa, Pseudomonas oleovorans* and Pseudomonas putida exhibited considerable growth. Decolourization in a liquid culture revealed that *Pseudomonas oleovorans* was more viable textile dyes.

CONCLUSION

It can be concluded from the present study that the indigenous microorganism has the ability to remediate the dye from the textile effluent. These observations has established that the bacteria are adaptive in nature and can degrade dye contaminants. The ability of the selected bacteria to tolerate and decolorize azo dyes present in dye effluent sample at high concentration gives an advantage for treatment of textile industry effluent. All the isolated bacterial species showed significant potential for dye decolorization and degradation. Further, it can be suggested that dye contaminated sites can potentially be recovered by a low cost bioremediation process with native bacterial species isolated from the textile effluent and dye disposal sites. The highest removal of reactive yellow color (about 90%) was obtained by bacterial Staphylococcus aureus after five days incubation . Thus, these selected bacteria can be employed as a vital biological tool for developing decentralized wastewater treatment systems for decolorization of dye effluents through biosorption or biodegradation which is a cost effective process.

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Table 1-Physico –chemical analysis of textile dye effluents

Name of the Parameters	Name of the dye effluent samples			NEQS*
	S1	S2	S3	
Temperature (°C)	35°C	45°C	38°C	40 °C
pH	7.9	9.2	8.6	6-9
Electrical conductivity (µS/cm)	) 223	248	237	80 - 450
Colour	Blackish blue	Ash	Blackish blue	Colourless
Odour	Unpleasant	Unpleasant	Unpleasant	Odourless
Total dissolved solid (mg/l)	2189	2398	2215	3500
Total suspended solids (mg/l)	128	179	154	-
Chemical oxygen demand (mg/l)	763	856	837	156

Biological oxygen demand (mg/l)	178	213	210	80-250
Dissolved oxygen (mg/l)	117	159	146	-
Total Hardness (mg/l)	295	320	306	-
Chloride (mg/l)	1124	1257	1177	-
Ca Hardness (mg/l)	185	220	197	-
Mg hardness (mg/l)	59.96	70.12	65.83	-

Table 2. Morphology of the selected isolates.

Microscopic Observation	***Bacillus* sp.**	***Staphylococcus aureus***
Shape	Short rod	Cocci
Arrangement	Single, double and in cluster	Cluster
Gram reaction	Positive	Positive
Capsule staining	Present	-

Table 3: Colony characters of the selected isolates.

Characteristics	***Bacillus* sp.**	***Staphylococcus aureus***
Size	Moderate	Small
Shape	Circular	Circular
Margin	Entire	Entire
Elevation	Raised	Raised
Consistency	Butyrous	Butyrous
Texture	Smooth	Smooth
Opacity	Opaque	Opaque
Pigmentation	Creamy white	Golden yellow

Table 4: Biochemical characteristics of the selected isolates.

Tests	**Media**	**Observation**	
		Bacillus sp	***S.aureus***
Starch Hydrolysis	Starch agar plate	+ve	-ve
Bacillus presence	MYP media	+ve	–ve
Citrate utilization	Simmons citrate agar slant	-ve	-ve
Methyl Red test	GPB Broth	-ve	+ve
Voges-Proskauer test	GPB Broth	+ve	–ve
Indole production	Indole test	+ve	–ve
Carbohydrate fermentation	Lactose	+ve	–ve
Carbohydrate fermentation	Dextrose	+ve	–ve
Carbohydrate fermentation	Sucrose	+ve	-ve
Oxidase test	Nutrient agar	+ve	–ve
Catalase test	Nutrient agar	+ve	+ve
H_2S production	TSI	+ve	-ve

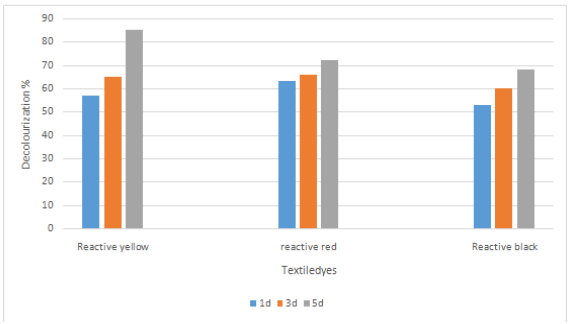

Fig 1: Decolorization of Reactive yellow, Reactive red and Reactive black dyes by *Bacillus sp.* after 1, 3 and 5 days.

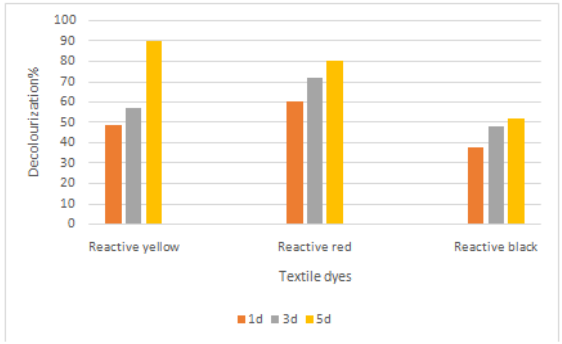

Fig 2: Decolorization of Reactive yellow, Reactive red and Reactive black dyes by *Staphylococcus aureus* after 1, 3 and 5 days.

RESEARCH ARTICLE

Pharmacalogical Evaluation of Ultra-Short Peptides in Alzheimers Disease

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ABSTRACT

Aim of This Research Work Was design, synthesis and evaluation of acetyl cholinesterase and betasecretase inhibitors. Synthesis by combinatorial chemistry using FMOC chemistry protocol, characterized by mass spectroscopy and sequence analysis using LC-MS-MS and evaluated by Ellman's method and fluorescence resonance energy transfer (FRET) assay. The compound UPS1 and UPS2 were found to be potent acetyl cholinesterase inhibition (0.739±0.456µg/mL) and (0.124±0.018 µg/mL) as compared with control AChE inhibitor donepezil(0.096±0.030µg/mL) and highly potent beta secretase inhibition (0.057±0.006µg/mL**)** and (0.114±0.007 µg/mL**)** than the control AChE inhibitor donepezil (0.096±0.030µg/mL). The dipeptides UPS1 and UPS2 were designed, synthesized and evaluated. The compounds were found to be potent acetyl cholinesterase and beta secretase inhibition as compared with control donepezil.

Keywords: Alzheimer's disease; Solid Phase Peptide Synthesis; Betasecretase; Acetylcholinesterase

INTRODUCTION

ALZHEIMER'S DISEASE

According to World Health Organization (WHO), dementia is a type of chronic or progressive clinical disorder, which involves declination of cognitive functions such as memory, thinking, orientation, understanding, attention,

etc. and consider it as a public health priority. [1] Throughout the world, dementia affects about 50 million of people with almost 10 million of new cases arising every year. However, WHO estimated that these numbers of people will not reach a limit but will projected to 82 million in 2030 and 152 million in 2050. [1] Basically, dementia can be categorized into two major groups, i.e. primary (irreversible) dementia and secondary (reversible) dementia. Primary dementia is relatively the most common type and is further classified into seven categories such as vascular dementia, dementia with Lewy bodies (DLB), mixed dementia, Parkinson's disease, frontotemporal dementia, Creutzfeldt-Jakob disease and normal pressure hydrocephalus. Studies showed that mental depression, hormonal deficiency, vitamin deficiency, anticholinergic medications, etc. are the factors that contribute to secondary dementia. [2] About 60 – 80% of the cases are related to Alzheimer's disease (AD), which is a complex neurodegenerative disorder and was firstly described by Alois Alzheimer in 1906. [3]

Besides aging, AD is caused by increased oxidative stress, deficiency of protein-folding capacity of the endoplasmic reticulum, as well as impaired proteasome- and autophagy-mediated clearance of damaged proteins. [4]Till today, the amyloid cascade hypothesis still appears to be the major motivation for all AD drug researchers. This theory proposed by Hardy and Higgins in 1992 suggested that the amyloid-beta protein (AβP) is the causative agent in AD pathology and as a result of its deposition, neurofibrillary tangles, cell loss, vascular damage, and dementia occur. [5] Based on this hypothesis, inhibition of Aβ accumulation in the brain would be beneficial in AD patients.

In AD patients, the two important cerebral lesions, senile plaques (SPs) and neurofibrillary tangles (NFTs) are observed. [6] SPs consist of AβPwhile NFTs composed of tau protein. The larger amyloid precursor protein (APP) which forms the AβP is found on the surface of the neuron in our brain. When β- and γ-secretaseenzyme sequentially cleaved the APP, AβP is thus formed and tends to misfold and becomes sticky, which then eventually clumping together to form soluble oligomers. Some of these aggregates into large insoluble fibrils that deposit in the brain as plaques. Studies have demonstrated that these oligomers weaken the communication and plasticity at synapses, thereby preventing the brain from creating or retrieving memories.Besides, Aβ42 was found to be the disease related isoform of Aβ and records for about 5-10% of the total Aβ produced. [6]

Apart from accumulation of AβP, neurofibrillary tangles with the main component of hyperphosphorylated and aggregated form of tau is also another pathologic marker of AD. [4] A signal called soma will travel from the body to the synapse to transfer the information when a neuron communicates with another neuron. The signal passes through the skeleton of the neuron consisting microtubules which stabilized by the normal tau protein. In AD, tau protein becomes defective causing it to dissociate from the microtubules, adopt an abnormal shape and move from the axon to the cell body. As a result, the skeleton of the neuron dissociate as it is no longer maintained. Defective tau protein then assemble to form filaments in the neuron. Without the skeleton, the neurons degenerate and connections between the neurons are lost. Addition of phosphate residues by certain enzymes results in the formation of hyperphosphorylated tau that is insoluble, lacks of affinity for microtubules and self-associates into paired helical filament structures. [7-8] The accumulation of abnormal tau fragments then create neurofibrillary tangles and are cytotoxic and impair cognition. [9]

Most of the drugs approved for AD treatment are acetylcholinesterase (AChE) inhibitors such as donepezil, tacrine, galantamine, and rivastigmine which improve the AChE level in the brain by inhibiting the hydrolysis of AChE. Recent evidence indicated certain links between Aβ and AChE. [10] Looking five years back, many pharmaceutical companies keep on discovering new drugs for the treatment of AD, but they are targeting the same beta-site amyloid precursor protein cleaving enzyme 1 (BACE1) to inhibit it and hence, lower the cerebral Aβ concentrations. Such compounds include JNJ-54861911, NB-360, MK-8931, etc. [11-13] Besides, studies have shown some compounds isolated from the natural sources are found to be the potential BACE1 inhibitors, for example, glycyrrhizin and its metabolites, 18α- and 18β-glycyrrhetinic acid from edible seaweed, *H. fusiformis*, as well as the major polymethoxyflavones isolated from black ginger *Kaempferia parviflora*.[14-15]

SOLID PHASE PEPTIDE SYNTHESIS (SPPS)

The general method for synthesizing peptides on a resin starts by attaching the amino acid compound (AA), from the C-terminal residue (carboxyl group), then proceeding with the peptide sequence construction to the N-terminal end. The amino acids are coupled to the supported peptide sequence by the alpha amino group and the reactive side chains are protected by a temporary protecting group. The carboxyl group of the corresponding amino acid must be activated for its coupling to the resin. Once the amino acid is attached, the resin is filtered and washed to remove byproducts and excess reagents. Next, the Na- protecting group of the new couple AA is removed (deprotection process) and therefore the rosin is once more washed to get rid of byproducts and excess reagents. Then, the next amino acid is coupled to the attached one. The cycle is repeated until the peptide sequence is complete. Then typically, all the protecting groups are removed, the resin is washed and the peptide is cleaved from the resin. The Fmoc strategy is often preferred over the Boc strategy for routine synthesis, because the former can be removed under milder conditions than the latter, representing an orthogonal deprotection scheme considering that most of linkers and protecting groups of amino acid residues can be de-protected under acidic conditions.17 However, the application of an in situ neutralization protocol15 has made the BOC chemistry the selected strategy for increasing the efficiency in difficult or longer peptide sequences even implemented in automated synthesizers.

The coupling of the organic compound represents a key tread an efficient SPPS, where a nearly quantitative yield is mandatory. The yield and scale of the solid-phase reactions are given with respect to the amount of this first amino acid coupled on to the resin. In particular, insects possess large depots of ABPs that are hugely resistant to the infections of bacteria and thus are prominent cell factories for genuine combinatorial chemistry of ABPs acquired during the long period of evolution of immune defense systems against environmental pathogens. AP had been considered as potential therapeutic alternatives to antibiotics due of their rapid effect, their non-toxicity toward the eukaryotic cells and bacterial resistance (15).Even though it does not displays membrane- disrupting activity (bacteriolytic action), AP shows bacteriostatic action especially toward the gram-negative bacteria such as *Helicobacter Pylori(14).* Mechanism of action of AP was binds to the lipopolysaccharide of the cell membrane initially and then to the protein DNAK which related chaperones of *E. coli* in a specific manner. In addition, all D-enantiomers are devoid of any measurable function, indicating a significant degree of stereo specificity (14).the ultra short peptides were synthesized by SPPS using Fmoc chemistry protocol. It is characterized by Mass spectroscopy and amino acid sequence analysis. Evaluated the inhibition against acetylcholinesterase and betasecretase enzyme of these peptides and discussed.

Based on current situation, peptides are the alternative of heterocyclic compounds in pharmaceutical industry. Short peptides are the linear molecules having two to twenty amino acids present in the sequence of the peptide. In the market today, there are more than 50 healing peptides existed and some of the peptides are still undergoing clinical trials(phase I, II & III).[16]Balancing of hydrophobic and hydrophilic characters (amphiphile) of peptides therefore becomes a new challenge in order to eliminate the risk factor of peptide delivery. [17]Studies have shown that short and ultra-short peptides are effectively suppressing the aggregation of Aβ and reducing its toxic effects based on the evidence in AD rodent animal models study. [18] Therefore, based on the above factors, two hypotheses are generated as a way to define the objectives of present research. to synthesize and study the inhibitory activity of compound USP1 and USP2 via *in-vitro AchE* and BACE1 assay.

MATERIALS AND METHODS

Chemicals and solvents

Chemicals, amino acids, coupling reagents, polymer bound resin and scavengers were received from SIGMA ALDRICH Pvt. Ltd. Solvents were received from SD fine Chem, Mumbai. DMSO was procured from E. Merck Ltd., Mumbai, India.

Chemicals and solvents

All amino acids, polymer bound resin, cleaving reagents and assay kits were purchased from Sigma Aldrich, Malaysia. Acetylthiocholine iodide (ATCI), sodium phosphate buffer and acetylcholinesterase (AChE) were purchased from SIGMA-ALDRICH. 5, 5-dithio-bis-(2-nitrobenzoic acid) (DTNB)from THERMO FISHER SCIENTIFIC. Buffers and other chemicals were of analytical grade. Betasecretase kit from SIGMA-ALDRICH.

Method

The peptide USP1 and USP2 were synthesized by SPPS using Fmoc chemistry protocol (21).

Design the peptide sequence

1. Designed the dipeptide containing hydrophobic amino acid and cationic amino acid equally present in the peptide sequence (USP1 & USP2).

USP1 – F W-$CONH_2$

USP2- F F W-$CONH_2$

Synthesis

Synthesis of the dipeptide (USP1 & USP2)

Sequence

USP1 – F W-$CONH_2$

USP2- F F W-$CONH_2$

Resin activation

About 500 mg rink amide MBHA resin was allowed to swell in dry DMF for about an hour and then the excess DMF was decanted (**Figure 1**). The resin was mixed with 10 mL 20% piperidine solution in DMF swirled for 8 minutes and then decanted. This procedure was used twice to ensure complete removal of the Fmoc protective group. The resin was washed with 6 mL of dry DMF (six times with 2 minute interval between the consecutive washes) before attaching the first amino acid to the resin

First amino acid attachment

Fmoc-Trp(Boc)-OH was mixed with HBTU and HOBT in 1 mL DMF. DIPEA was added to the above milky colloidal solution and sonicated to get a clear solution. The mixture became a transparent yellow colour solution after one minute. Then the contents were mixed with the activated resin and gently shaken for 90 minutes continuously (**Figure 2**). Then the resin was washed with 6 mL of dry DMF (six times with 2 minute interval between the consecutive washes) to remove the excess of unreacted amino acid active ester. The negative result of ninhydrin test indicated 100% attached to the rein.

FMOC deprotection and coupling of remaining amino acid

After washing the resin with dry DMF, using 10 mL of 20% piperidine solution was added and shaken for 8 minutes and this was used twice (Figure 3). Finally the resin was washed with 6 mL of dry DMF (six times with 2 minute interval between the consecutive washes). The positive result of ninhydrin test indicated 100% removal of Fmoc from the resin. USP1 was synthesized by SPPS using a manual peptide synthesizer.

Cleavage of the peptide USP1 from resin

The peptide bound resin was extensively washed two times with 10 mL of DCM, 10 mL of glacial acetic acid followed by 10 mL of DCM twice and finally with 10 mL of solvent ether for two times (Figure 4). Then the peptide bound resin was treated with a mixture of 0.2 mL ethanedithiol, 0.2 mL m-cresol and 7 mL TFA. The contents were occasionally shaken for one hour, filtered and washed the resin with TFA and the filtrate was concentrated under high vacuum to remove the residual TFA to get solid mass. The solid mass was triturated with ice-cold ether and centrifuged to decant ether. The white precipitate obtained was dried under the stream of nitrogen and stored in a refrigerator until further study.

Cleavage of the peptide USP2 from resin

The peptide bound resin was extensively washed two times with 10 mL of DCM, 10 mL of glacial acetic acid followed by 10 mL of DCM twice and finally with 10 mL of solvent ether for two times (Figure 5). Then the peptide bound resin was treated with a mixture of in dole 0.250 gm, 0.2 mL ethanedithiol, 0.2 mL m-cresol and 7 mL TFA. The contents were occasionally shaken for one hour, filtered and washed the resin with TFA and the filtrate was concentrated under high vacuum to remove the residual TFA to get solid mass. The solid mass was triturated with ice-cold ether and centrifuged to decant ether. The white precipitate obtained was dried under the stream of nitrogen and stored in a refrigerator until further study.

CHARACTERIZATION

Mass spectroscopy

The molecular mass of peptides was performed in API-3000 sciex mass spectrometer (LC-MS-MS). AGILENT 1200 series Binary pump was used in sample introduction to mass spectrometer. C18 column was used and the size of the column was AGILENT XDB 150 mm, 4.6 mm, 5 µ. About 10µL of the peptide solutions in water was injected into the mobile phase composed of 10 mM ammonium acetate and methanol (50:50) mixture.

***IN-VITRO* ACETYLCHOLINEATERASE (AChE) ASSAY**

The assay for measuring AChE activity was evaluated based on Ellman's method.[22] The principle of this method is based on enzyme hydrolyzes the substrate acetylthiocholine iodide (ATCI) into thiocholine and acetic acid. Then, thiocholine can react with 5,5-dithio-bis-(2-nitrobenzoic acid) (DTNB) and formation of yellow color. The intensity of the color formation is directly proportional to the activity of the enzyme. Briefly, 150 µl of 0.1 M sodium phosphate buffer (pH 8.0), 10 µl of the test compound, and 20 µl of the enzyme solution (0.1 units/mL) were added and incubated for 15 min at 25°C. After that, mixed with 10 µl of DTNB (10 mM) and 10 µl of ATCI (14 mM) to initiate the reaction, incubate for 10 min. The color formation was measured at 410 nm wavelength. The controls contained the solvent to dissolve the compound instead of test compound. The percentage inhibition for each test solution was then calculated using the following equation:

Inhibition (%) = (1–absorbance sample/absorbance control) ×100

***IN-VITRO* BETA-SECRETASE (BACE1) ASSAY**

Screening β-secretase inhibitors using purified enzyme [23]

Compounds at concentration ranging from 0.1-100 µg/ml were assayed for BACE1 inhibition using a fluorescence resonance energy transfer (FRET) assay. This assay uses baculovirus-expressed BACE1 and peptide substrate based on Swedish mutation of APP. The mutation dramatically enhances the cleavage of APP by BACE1 enzyme and this peptidic substrate becomes highly fluorescent upon enzymatic cleavage. A mixture of 10µl of test compound diluted in assay buffer, 10µl of BACE1 substrate (Rh-EVNLDAEFK-quencher, in 50 nM ammonium bicarbonate) and 10µl of BACE1 enzyme (1.0 U/ml) were incubated for 60 minutes at room temperature in a dark condition. After that, 10µl of BACE1 stop buffer (2.5M sodium acetate) was added to the mixture. The fluorescence was read by using a spectrofluorometer (TECAN) under the excitation at 545 nm and emission at 585 nm. The percentage of BACE1 inhibition was measured using the equation below.

BACE1 inhibition (%) = [1 – test sample / positive control] x 100

RESULTS AND DISCUSSION

Synthesis

The dipeptides were designed by SPPS using Fmoc chemistry protocol. The structural integrity and amino acid sequence analysis of the peptides were confirmed by LC-MS-MS method. It was clear from the mass spectral data that the chemical entity USP1 and USP2 were present as indicated by the appearance of an M+1 peak at 352.2 and 450.4 the centroid spectrum of the compounds are shown in the Table 1.

***In-vitro* acetylcholinesterase (AchE) assay**

The assay of acetylcholinesterase was based on an improved Ellman method in a 96 well plate reader using Quanti Chrome assay kit (USA). One of the characteristic changes that occur in AD is increase in acetyl cholinesterase (AChE) activity, the enzyme responsible for acetylcholine hydrolysis, from both cholinergic and non-cholinergic neurons of the brain. The results obtained from the octa peptides related to human histatin 8 against AChE enzyme inhibition activity and the percentage inhibition was evaluated and tabulated in Table 2 and 3 .IC_{50} value of USP1 & USP2 were found to be 0.739±0.456μM/mL and 0.124±0.018 μM/mL. However, these compounds are shown to be highly effective as compared with control AChE inhibitor donepezil (0.065 ±0.0050 μg/mL).

***In-vitro* Betasecretase (BACE 1) assay**

The assay of beta-secretase was based on fluorescence resonance energy transfer (FRET) method using Swedish mutation of amyloid precursor protein (APP). One of the characteristic changes that occur in AD is increase in beta-secretase enzyme (BACE1) activity, the enzyme responsible for β Amyloid (Aβ) formed by the continuously proteolytic processing of β -amyloid precursor protein (APP) by β- secretase and γ-secretase, plays a vital part in the pathogenesis of AD. The results obtained from the hexa peptides related to apidaecin IA against BACE 1 enzyme inhibition activity and the percentage inhibition was evaluated and tabulated in Table 4 and Table 5 and the IC50 value of USP1 & USP2 were found to be 0.057±0.006 μM/mL and 0.114±0.007 μM/mL.

STATISTICAL ANALYSIS

Data were presented as mean ± standard deviation (SD). All analyses were carried out in triplicates. Graph Pad Prism 5 and Microsoft Excel 2007 were used for the statistical and graphical evaluations.

DISCUSSION

Short and ultra-short peptide residues have been identified and reported to be active against acetylcholinesterase and beta secretase enzyme for the treatment of Alzheimer's disease (2425). Ionic/charge interactions may play a prominent role in age-related degenerative diseases such as Alzheimer's disease (26). In general, peptides are rapidly degraded by proteases, and their nature implies problem for administration and delivery, especially to the brain. These problems can be overcome as peptide chemistry permits a variety of methods for peptide modification or the use of D-enantiomeric amino acid residues (27). Another possible causative factor is to overcome the risk factor of peptide delivery, balancing of hydrophobic and hydrophilic characters (Amphiphile) (6). Significance of non-lytic short antimicrobial peptides is better for pharmaceutical applications (28). Based on the above reports, USP1 was found to be potent inhibition of acetylcholinesterase and betasecretase enzyme which is the causative reagent for β Amyloid (Aβ) formed by the continuously proteolytic processing of β -amyloid precursor protein (APP) by β-secretase and γ-secretase, plays a vital part in the pathogenesis of AD (2). Recent evidence indicated certain links between Aβ and AChE (29).

CONCLUSION

The compounds USP1 & USP2 were synthesized by combinatorial chemistry using FMOC chemistry protocol and evaluated acetylcholinesterase and betasecretase inhibition by Ellmans method and fluorescence resonance energy transfer (FRET) assay method. The compounds USP1 & USP2 were shown to be highly potent inhibitor as compared with control AChE inhibitor donepezil.

CONFLICT OF INTEREST

The author declares that there is no conflict of interest.

FUNDING

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Table 1. Mass spectrum of USP1 and USP2

S. No	Compound code	Molecular formula	Molecular weight	Mass peak
01	USP1	$C_{20}H_{24}N_4O_2$	350	352.2
02	USP2	$C_{26}H_{32}N_4O_3$	448	450.4

Table 2. In vitro acetylcholinesterase inhibition of USP1& USP2

Compound name	% inhibition				IC_{50} μM/mL
Concentration of the compound (μM/mL)	0.1	1	10	100	
USP1	15.08±0.14	42.32±0.36	65.12±0.24	82.27±0.29	0.739±0.456
USP2	13.09±0.18	61.22±0.14	82.56±0.32	91.97±0.14	0.124±0.018
Donepezil	68.38±0.14	91.29±0.18	94.09±0.19	96.13±0.17	0.096±0.030

All the values are mean ± SD (*n* = 3)

Table 3. IC_{50} value of USP1 and control

S. No	Compounds Code	IC_{50} µM/mL
01	USP1	0.739±0.456
01	USP2	0.124±0.018
02	DONEPEZIL	0.096±0.030

All the values are mean ± SD (*n* = 3)

Table 4. In vitro betasecretase inhibition of USP1 & USP2

Compound name	% inhibition				IC_{50} µM/mL
Concentration of the compound (µM/mL)	0.1	1	10	100	
USP1	40.24±0.32	73.46±0.23	82.47±0.33	91.54±0.28	0.057±0.006
USP2	61.29±0.23	89.22±0.33	93.70±0.14	95.51±0.18	0.114±0.007
Donepezil	68.38±0.14	91.29±0.18	94.09±0.19	96.13±0.17	0.096±0.030

All the values are mean ± SD (*n* = 3)

Table 5. IC50 value of USP1, USP2 and control

S. No	Compounds Code	IC50 µM/mL
01	USP1	0.057±0.006
01	USP2	0.114±0.007
02	DONEPEZIL	0.096±0.030

All the values are mean ± SD (*n* = 3)

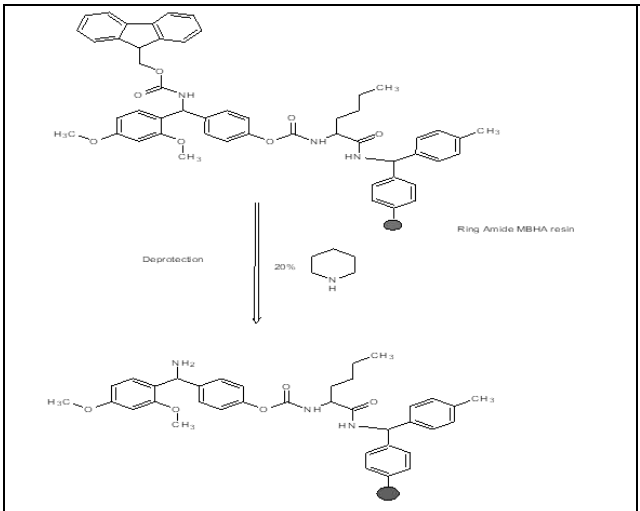

Figure 1 Deportation of resin

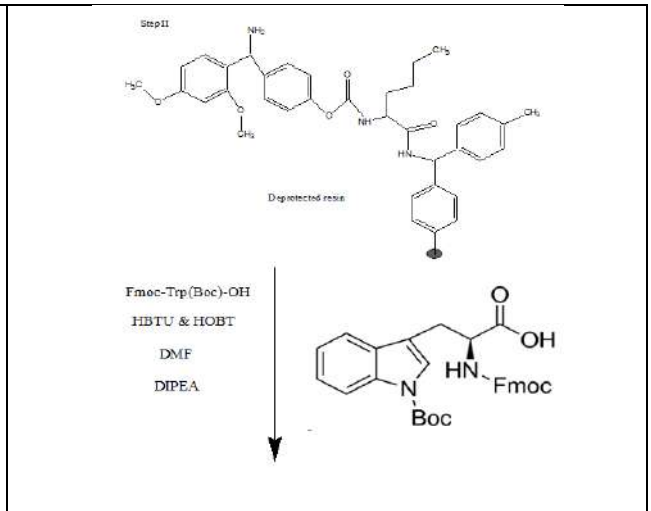

Figure 2 First amino acid attachment with resin

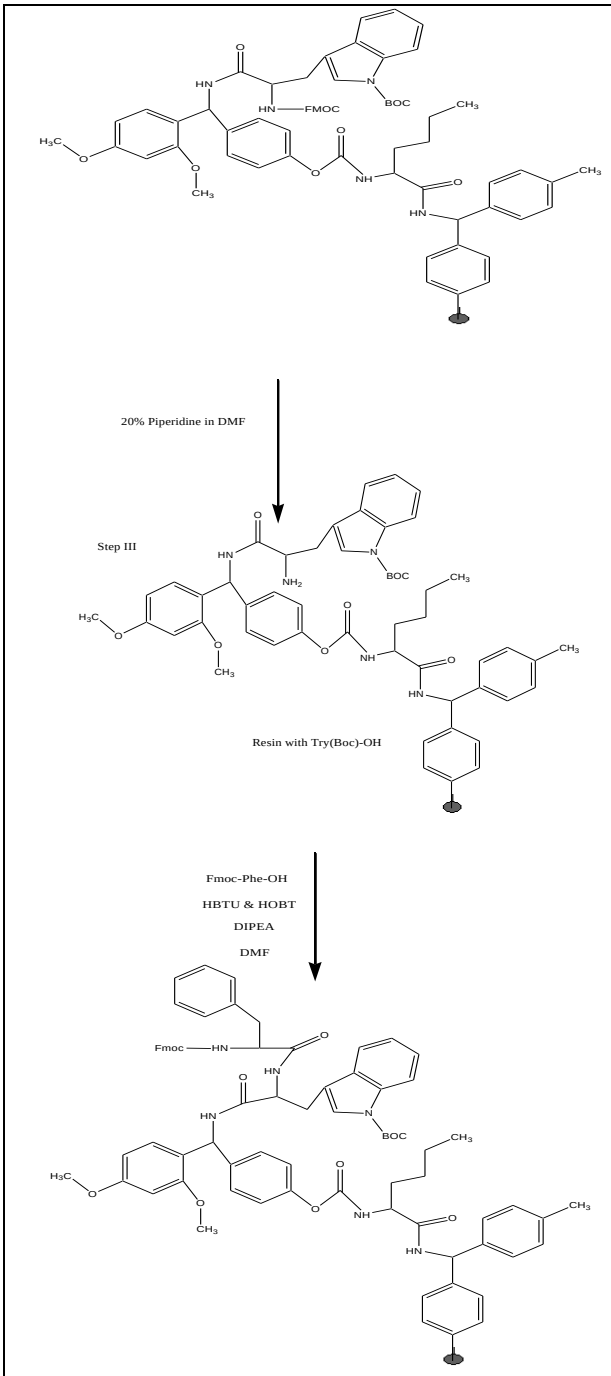

Figure 3 FMOC deprotection and coupling of remaining amino acid

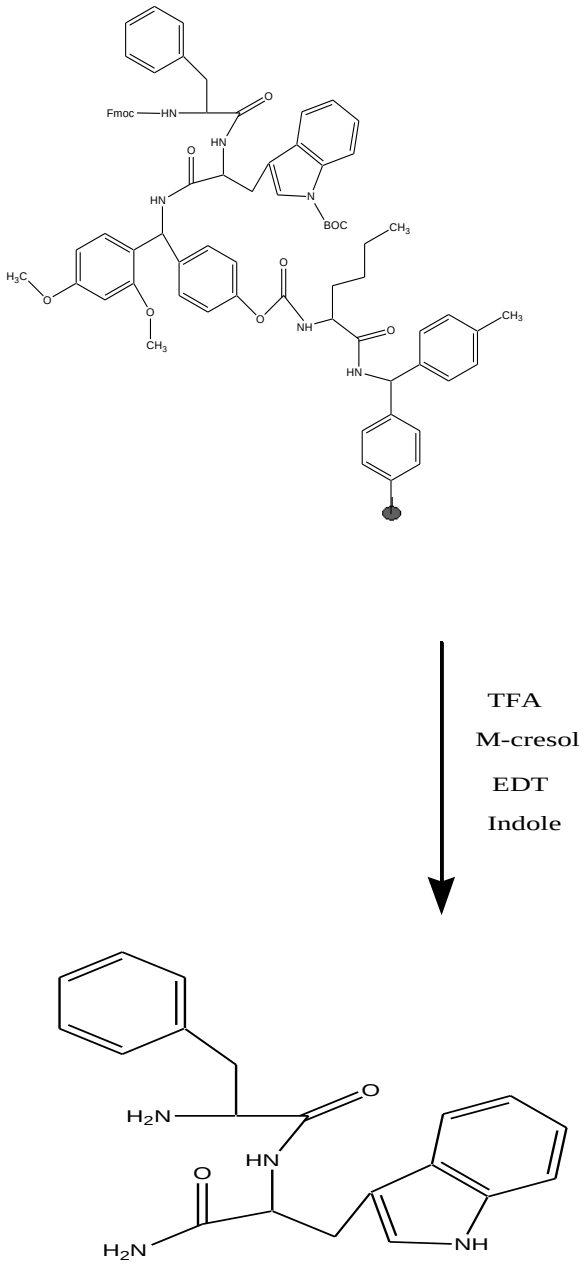

Figure 4 Cleavage of the peptide USP1 from resin

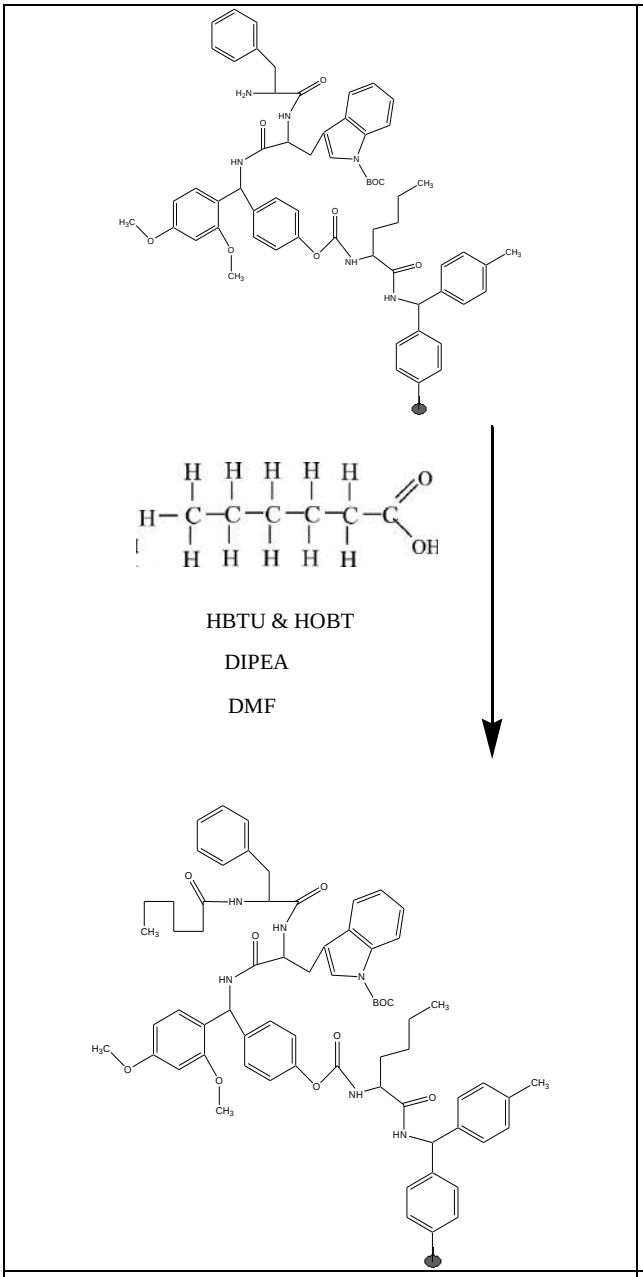

Figure 5 FMOC deprotection and coupling of remaining amino acid

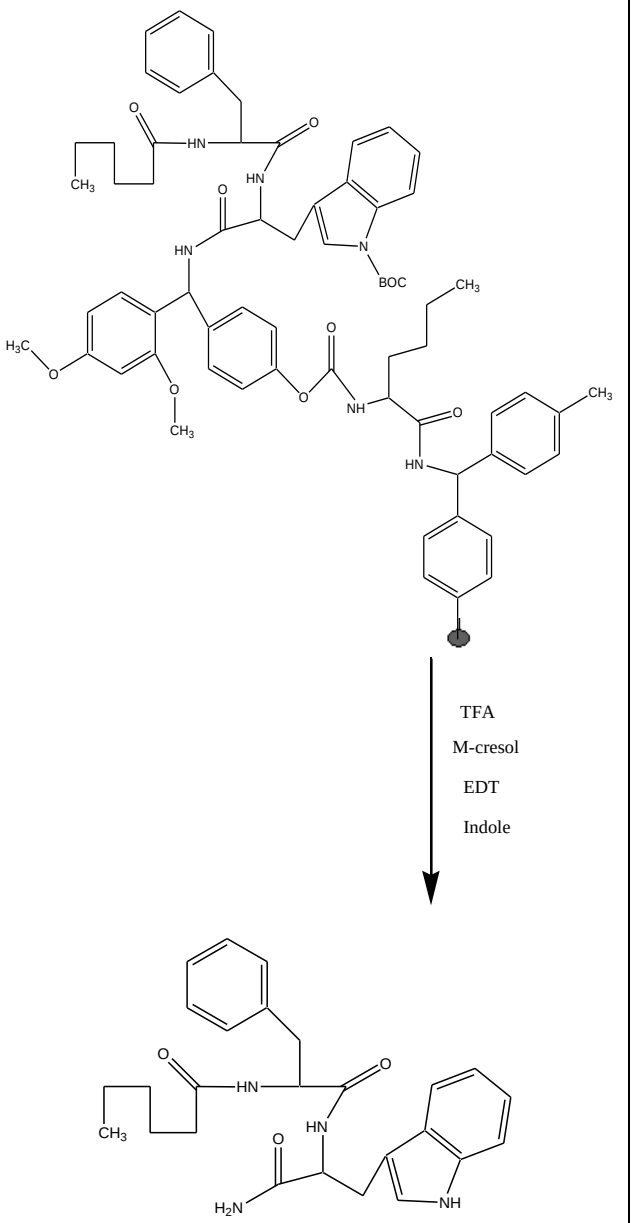

Figure 6 Cleavage of the peptide USP2 from resin

RESEARCH ARTICLE

Non Markovian Single Server Retrial G- Queue with Working Breakdown and Working Vacation

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ABSTRACT

At any time, a normally busy server can become faulty due to negative consumers. Negative consumers only arrive at a positive customer's service time and eliminate the good client from the service. The primary server is dispatched for repair at the time of breakdown, and the repair period commences instantly. The server continues to offer service at a working breakdown rate while it is being repaired. To obtain the steady state pgf for system size and orbit size, the approach of supplementary variables is used.

Keywords : Retrial queue, G-queue, working breakdown, working vacation

INTRODUCTION

Retrial queues have been a fascinating research field in queueing theory over the past two decades. Many researchers interested with a great effort of the concept of retrial queues refer [1], [2]. In computers, neural networks, and communication networks, Gelenbe (1989) is the first to establish the perception of negative clients (also known as G-queue). Only negative clients showed up at the usual time for positive customers to receive service. Negative consumers will remove positive clients who are already in service from the system, and they will not be able to form a line and not receive service. These kinds of poor customers disrupt servers and cause service failure for a brief period of time. When a primary server fails, it is dispatched to be repaired, and the repair process begins instantly.

Kalidass and Ramnath [7] are the ones who first proposed the concept of working breakdowns (2012). Disasters might cause the system to fail at any time. The customer is served by a substitute server while the original server is being rigid. The primary server rejoins the system and becomes available once the repair is completed. Kim and Lee [8] (2014) dealt with disasters and failures in a non-Markovian single server queuing system. The analytical results in this model are quite valuable and helpful for decision makers when designing a management policy. This model has potential applications in medical service systems for telephone consultation, inventory systems, and stochastic production challenges.

MODEL DESCRIPTION

The arrival of the client is classified into two types in our model as positive and negative customers. Customers who are positive arrive via a Poisson process with rate λ, whereas those who are negative arrive via a Poisson process with rate δ. With Laplace-Stieltjes Transforms (LST)$I^*(\theta)$, inter-retrial periods have an arbitrary distribution I(x). The service time is distributed with parameterμ. During the idle state, the server begins normal service when a new positive client or a retry positive customer arrives. With Laplace-Stieltjes Transforms (LST)$S^*(\theta)$, sevice time have general distribution function S(x). Negative customers only show up during the positive customers' service time. The entrance of the negative customers causes the good customers to be removed from the system, preventing them from receiving service. Thesedisgruntled consumers are to blame for the server failure and the service channel's inability to provide service for a brief period of time. The server is dispatched to be repaired after a breakdown occurs, and the process begins right away. The repair time is distributed in an exponential manner with parameterη. When a negative customer comes in on a regular busy server, the server has a breakdown. The substitute server delivers a decreased rate of service during the working breakdown period ($\mu_w < \mu$). When the repair is completed, the server resumes its normal operating mode. With Laplace-Stieltjes Transforms (LST)$S_w^*(\theta)$ lower sevice time have an distribution function S_w (x). When the orbit becomes empty, the attendant is going on vacation with parameterθ. During the working vacation, the server provides a lower level of service to arriving customers ($\mu_w < \mu$)

ANALYSIS OF THE SYSTEM

Notations and Probabilities

$r(x) =$ retrial completion rate I(x)
$r(x)dx = \frac{dI(x)}{1-I(x)}$.

$\mu(x) =$ normal service completion rate S(x)
$\mu(x)dx = \frac{dS(x)}{1-S(x)}$.

$\mu_w(x) =$ completion rate for lower service $S_w(x)$
$\mu_w(x)dx = \frac{dS_w(x)}{1-S_w(x)}$

Steady State Equations

The number of consumers in the orbit at time t is $N(t) = n(n \geq 0)$, and the server states are C(t)=0,1,2,3. the server is idle in lower service, idle in normal service, busy in normal service, busy in lower service respectively.Let's use the subsequent random variables.

In steady state, I(0) = 0, I(∞) = 1, S(0) = 0, S(∞) = 1, Sw(0) = 0, Sw(∞) = 1 are continuous at x = 0.
To generate a bivariate Markov process, further variables are introduced $\{(C(t), N(t)); t \geq 0\}$.

$$P_0(t) = P\{C(t) = 1, N(t) = 0\}$$

$$W_0(t) = P\{C(t) = 0, N(t) = 0\}$$

$$I_n(x,t)dx = P\{C(t) = 1, N(t) = n, x \le I^0(t) < x + dx\}, (x,t) \ge 0, n \ge 1$$

$$\pi_n(x,t)dx = P\{C(t) = 2, N(t) = n, x \le S_b^0(t) < x + dx\}, (x,t) \ge 0, n \ge 0$$

$$W_n(x,t)dx = P\{C(t) = 3, N(t) = n, x \le S_w^0(t) < x + dx\}, (x,t) \ge 0, n \ge 0$$

$$P_0 = lim_{t\to\infty} P_0(t)$$

$$W_0 = lim_{t\to\infty} W_0(t)$$

$$I_n(x) = lim_{t\to\infty} I_n(x,t)$$

$$\pi_n(x) = lim_{t\to\infty} \pi_n(x,t)$$

$$W_n(x) = lim_{t\to\infty} W_n(x,t)$$

In steady state the system was illustrated by the subsequent differential equations:

$$\boldsymbol{\lambda P_0 = (\theta + \eta) W_0}, \quad (1)$$

$$(\lambda + \theta + \eta)W_0 = \int_0^\infty \pi_0(x)\mu(x)dx + \int_0^\infty W_0(x)\mu_w(x)dx + \delta \int_0^\infty \pi_n(x)dx, \quad n \ge 0 \quad (2)$$

$$\frac{dI_n(x)}{dx} + (r(x) + \lambda)I_n(x) = 0, \; n \ge 1 \quad (3)$$

$$\frac{d\pi_0(x)}{dx} + (\mu(x) + \lambda + \delta)\pi_0(x) = 0, \; n = 0 \quad (4)$$

$$\frac{d\pi_n(x)}{dx} + (\mu(x) + \lambda + \delta)\pi_n(x) = \lambda\, \pi_{n-1}(x), \; n \ge 1T \quad (5)$$

$$\frac{dW_0(x)}{dx} + \left(\mu_w(x) + \lambda + \eta + \theta + \right)W_0(x) = 0, \quad n = 0 \quad (6)$$

$$\frac{dW_n(x)}{dx} + (\mu_w(x) + \lambda + \eta + \theta)W_n(x) = \lambda\, W_{n-1}(x), \quad n \ge 1 \quad (7)$$

At $x = 0$,

$$I_n(0) = \int_0^\infty \pi_n(x)\, \mu(x)\, dx + \int_0^\infty W_n(x)\mu_w(x)\, dx, \quad n \ge 1 \quad (8)$$

$$\pi_0(0) = \int_0^\infty I_1(x)\, r(x)dx + (\theta + \eta) \int_0^\infty W_0(x)\, dx + \lambda P_0, \; n = 0 \quad (9)$$

$$\pi_n(0) = \int_0^\infty I_{n+1}(x)r(x)dx + (\theta + \eta) \int_0^\infty W_n(x)\, dx + \lambda \int_0^\infty I_n(x)dx, \quad n \ge 0. \quad (10)$$

$$W_n(0) = \begin{cases} \lambda W_0, n = 0 \\ 0, n \geq 1 \end{cases} \quad (11)$$

$$P_0 + W_0 + \sum_{n=1}^{\infty} \int_0^{\infty} I_n(x)dx + \sum_{n=1}^{\infty} \left[\int_0^{\infty} \pi_n(x)dx + \int_0^{\infty} W_n(x)dx\right] = 1 \quad (12)$$

$$I(x,z) = \sum_{n=1}^{\infty} I_n(x)z^n;\ \pi(x,z) = \sum_{n=1}^{\infty} \pi_n(x)z^n\ ;\ W(x,z) = \sum_{n=1}^{\infty} W_n(x)z^n$$

$$I(0,z) = \sum_{n=1}^{\infty} I_n(0)z^n; \pi(0,z) = \sum_{n=1}^{\infty} \pi_n(0)z^n;\ W(0,z) = \sum_{n=1}^{\infty} W_n(0)z^n$$

Multiply the equations (3) with z^n and summing over1 to ∞, we get

$$\frac{dI(x,z)}{dx} + \big(\lambda + r(x)\big)I(x,z) = 0 \quad (13)$$

Multiply the equations (5) with z^n and summing over1 to ∞ and adding the resultant of (4), we get

$$\frac{d\pi(x,z)}{dx} + (\lambda(1-z) + \delta + \mu(x))\pi(x,z) = 0 \quad (14)$$

Multiply the equations (7) with z^n and summing over1 to ∞ and adding the resultant of (6), we get,

$$\frac{dW(x,z)}{dx} + (\lambda(1-z) + \theta + \eta + \mu_w(x))W(x,z) = 0 \quad (15)$$

$$I(0,z) = \int_0^{\infty} \pi(x,z)\,\mu(x)\,dx + \int_0^{\infty} W(x,z)\,\mu_w(x)\,dx - \int_0^{\infty} \pi_0(x)\,\mu(x)\,dx - \int_0^{\infty} W_0(x)\mu_w(x)\,dx \quad (16)$$

$$\pi(0,z) = \frac{1}{z}\int_0^{\infty} I(x,z)r(x)dx + \lambda \int_0^{\infty} I(x,z)dx + (\theta+\eta)\int_0^{\infty} W(x,z)dx + \lambda P_0 \quad (17)$$

$$W(0,z) = \lambda W_0 \quad (18)$$

Solving equations (13), (14), (15) which yields

$$I(x,z) = e^{-\lambda\ x}\ (1 - I(x))\ I(0,z) \quad (19)$$

$$\pi(x,z) = e^{-\mathrm{A}(z)x}[1 - S(x)]\ \ \pi(0,z) \quad (20)$$

$$W(x,z) = \ e^{-A_w(z)\,x}[1 - S_w(x)]\pi(0,z) \quad (21)$$

where $A(z) = \lambda(1-z) + \delta$, $A_w(z) = \lambda(1-z) + \theta + \eta$

Substitute (19), (20)and(21) in (17) and get

$$\pi(0,z) = \lambda P_0 + \lambda W_0 V(z) + \frac{I\,(0,z)}{z}\left[I^*(\lambda) + z\left(1 - I^*(\lambda)\right)\right] \quad (22)$$

where $V(z) = \frac{(\theta+\eta)(1-S_w^*(A_w(z))}{A_w(z)}$

Using equations (19), (20), (21)and(22) in (16), we get

$$I(0,z) = W(0,z)\, S_w^*\big(A(z)\big) - (\lambda + \theta + \eta)W_0 + \pi(0,z)[S^*(A(z)) + S(z)] \quad (23)$$

where $S(z) = \frac{\big(1-S^*(A(z))\big)\delta}{\lambda\,(1-z)+\delta}$

Using equations (18) and (22) in equation (23), we get

$$z - [I^*(\lambda) + z\,(1 - I^*(\lambda))][S^*(A(z)) + S(z)]]I(0,z) = zW_0[\,(\lambda V(z) + \theta + \eta)\left(S^*\big(A(z)\big) + S\,(z)\right)\,] + \lambda\left(S_w^*\big(A_w(z)\big) - 1 - (\theta+\eta)\right] \quad (24)$$

Let, f(z) = $z - [I^*(\lambda) + z\,(1 - I^*(\lambda))][S^*(A(z)) + S(z)]]$ for f(z) = 0

we obtain f(0) <0 and f(1) >0 whichimplies that ∃ a real root $z_1 \in (0,1)$

From equation (24)

$$I(0,z) = \frac{zW_0[(\lambda V(z)+\theta+\eta)(S^*(A(z))+S(z))+\lambda(S_w^*(A_w(z))-1)-(\theta+\eta)]}{z-[I^*(\lambda)+z(1-I^*(\lambda))][S^*(A(z))+S(z)]} \quad (25)$$

Using the equation (25) in equation (22),

$$\pi(0,z) = \frac{W_0\{z(\lambda V(z)+\theta+\eta)+(\lambda(S_w^*(A_w(z))-1)-(\theta+\eta))(I^*(\lambda)+z(1-I^*(\lambda)))\}}{z-[I^*(\lambda)+z(1-I^*(\lambda))][S^*(A(z))+S(z)]} \quad (26)$$

Using equations (18),(25),(26) in (19), (20), (21) then (PGFs) are $I(x,z)$, $\pi(x,z)$ and $W(x,z)$

STEADY STATE RESULTS

If$\frac{\lambda}{\delta}(1 - S^*(\delta)) < I^*(\lambda)$,the PGF's are as follows:

(i) The number of consumers in orbit as the server is idle.

$$I(z) = \frac{zW_0(1-I^*(\lambda))\left\{\left(S^*(A(z))+S\,(z)\right)(\lambda V(z)+\theta+\eta)+\lambda\,(S_w^*(A_w(z))-1)-(\theta+\eta)\right\}}{\lambda(z-[S^*(A(z))+S(z)][I^*(\lambda)+z(1-I^*(\lambda))])} \quad (27)$$

(ii) The number of consumers as the server is regularly busy

$$\pi(z) = \frac{W_0\big(1-S^*(A(z))\big)\left\{z(\lambda V(z)+\theta+\eta)+\big(I^*(\lambda)+z(1-I^*(\lambda))\big)\left(\lambda(S_w^*(A_w(z))-1)-(\theta+\eta)\right)\right\}}{A(z)(z-[I^*(\lambda)+z(1-I^*(\lambda))][S^*(A(z))+S(z)])} \quad (28)$$

(iii) The number of consumers as the server is lower speed service

$$\mathrm{W(z)} = \frac{\lambda \mathrm{W}_0 1-S_w^*(A_w(z))}{(A_w(z))} \quad (29)$$

If the number of customers in the system $C_u(z)$ is calculated using the PGF,

$$C_u(z) = P_0 + W_0 + I(z) + z(\pi(z) + W(z))$$

$$C_u(z) = \frac{W_0\{\left(\frac{\theta+\eta}{\lambda}+1\right)A_w(z)A(z)\lambda G(z)+z(1-I^*(\lambda))A_w(z)A(z)T(z)+\lambda z A_w(z)\left(1-S^*(A(z))\right)U(z) \\ +\lambda^2 z\left(1-S_w^*(A_w(z))\right)G(z)\}}{A(z)\lambda\, A_w(z)\,(z-[I^*(\lambda)+z(1-I^*(\lambda))][S^*(A(z))+S(z)])} \quad (30)$$

If the number of customers in the orbit $C_0(z)$ is calculated using the PGF,

$$C_0(z) = P_0 + W_0 + I(z) + \pi(z) + W(z)$$

$$C_0(z) = \frac{W_0\{\left(\frac{\theta+\eta}{\lambda}+1\right)A_w(z)A(z)\lambda G(z)+z(1-I^*(\lambda))A_w(z)A(z)T(z)+\lambda A_w(z)\left(1-S^*(A(z))\right)U(z) \\ +\lambda^2\left(1-S_w^*(A_w(z))\right)G(z)\}}{A(z)\lambda\, A_w(z)\,(z-[I^*(\lambda)+z(1-I^*(\lambda))][S^*(A(z))+S(z)])} \quad (31)$$

Where

$G(z) = z - \left[I^*(\lambda) + z\left(1 - I^*(\lambda)\right)\right]\left[S^*\left(A(z)\right) + S(z)\right]$

$T(z) = \left(S^*\left(A(z)\right) + S\,(z)\right)\left(\lambda V(z) + \theta + \eta\right) + \lambda\left(S_w^*\left(A_w(z)\right) - 1\right) - (\theta + \eta)$

$U(z) = z\left(\lambda V(z) + \theta + \eta\right) + \left(I^*(\lambda) + z\left(1 - I^*(\lambda)\right)\right)\left(\lambda\left(S_w^*\left(A_w(z)\right) - 1\right) - (\theta + \eta)\right)$

using normalizing condition , we find P_0 , W_0 by putting z=1 and we apply L's hospital rule,

$$P_0 + W_0 + I(1) + \pi(1) + W(1) = 1$$

$$W_0 = \frac{I^*(\lambda) - \frac{\lambda}{\delta}(1-S^*(\delta))}{I^*(\lambda)\left(\frac{\theta+\eta}{\lambda}+1\right)+\frac{\lambda}{\theta+\eta}\left(1-S_w^*(\theta+\eta)\right) - \frac{\lambda}{\delta}S_w^*(\theta+\eta)(1-S^*(\delta))} \quad (32)$$

$$P_0 = \frac{I^*(\lambda) - \frac{\lambda}{\delta}(1-S^*(\delta))}{\frac{\lambda}{\theta+\eta}\{I^*(\lambda)(\frac{\theta+\eta}{\lambda}+1)+\frac{\lambda}{\theta+\eta}\left(1-S_w^*(\theta+\eta)\right) - \frac{\lambda}{\delta}S_w^*(\theta+\eta)(1-S^*(\delta))\}} \quad (33)$$

SYSTEM PERFORMANCE MEASURES

Let I be the steady state probability that the server is idle durimg the retrial

$$I(1) = \frac{(1-I^*(\lambda))W_0\{\left(1-S_w^*(\theta+\eta)\right)(\frac{\lambda}{\theta+\eta}+\frac{\lambda}{\delta(1-S^*(\delta))})+\frac{\theta+\eta}{\delta}(1-S^*(\delta))\}}{(I^*(\lambda) - \frac{\lambda}{\delta}(1-S^*(\delta)))} \quad (34)$$

Let π be the steady state probability that the server is busy

$$\pi(1) = \frac{W_0(1-S^*(\delta)\{\lambda(1-S_w^*(\theta+\eta))(\frac{\lambda}{\theta+\eta}+I^*(\lambda))+(\theta+\eta)I^*(\lambda)}{\delta\left(I^*(\lambda) - \frac{\lambda}{\delta}(1-S^*(\delta))\right)} \quad (35)$$

Let W be the steady state probability that the server is at lower speed service

$$W(1) = \frac{\lambda W_0}{\theta+\eta}(1 - S_w^*(\theta + \eta)) \quad (36)$$

$$W_{wb} = W + W_0 = \frac{W_0((\theta+\eta)+\lambda(1-S_w^*(\theta+\eta))}{\theta+\eta} \quad (37)$$

$$S_f = \delta\pi(1) = \frac{W_0(1-S^*(\delta)\{\lambda(1-S_w^*(\theta+\eta))(\frac{\lambda}{\theta+\eta}+I^*(\lambda))+(\theta+\eta)I^*(\lambda)\}}{I^*(\lambda)-\frac{\lambda}{\delta}(1-S^*(\delta))} \quad (38)$$

The mean number of customers in the systemL_s under steady state condition is obtained by differentiating (30) with respect to z and put z = 1 , we get

$$L_s = C_u'(1) = \lim_{z\to 1}\frac{d}{dz}C_u(z)$$

$$L_s = \frac{Nr''(1)Dr'(1)-Dr''(1)Nr'(1)}{2\left(Dr'(1)\right)^2}$$

Where

$$Nr(z) = W_0\{\left(\frac{\theta+\eta}{\lambda}+1\right)A_w(z)A(z)\lambda G(z) + z\left(1-I^*(\lambda)\right)A_w(z)A(z)T(z) + \lambda z A_w(z)\left(1-S^*\left(A(z)\right)\right)U(Z) + \lambda^2 z\left(1-S_w^*\left(A_w(z)\right)\right)G(z)\}$$

$$Dr(z) = A(z)\,\lambda\,A_w(z)\,(z-\left[I^*(\lambda)+z\left(1-I^*(\lambda)\right)\right]\left[S^*\left(A(z)\right)+S(z)\right])$$

Differentiating P(z), T(z) and G(z) two times with respect to z and z = 1, we get

$$G'(1) = I^*(\lambda) - \frac{\lambda}{\delta}(1-S^*(\delta))$$

$$T'(1) = [\frac{\lambda}{\delta}(1-S^*(\delta))][\lambda(1-S_w^*(\theta+\eta)+(\theta+\eta)] + \frac{\lambda^2}{\theta+\eta}\left(1-S_w^*(\theta+\eta)\right)$$

$$U'(1) = \frac{\lambda^2}{\theta+\eta}\left(1-S_w^*(\theta+\eta)\right) + [\lambda(S_w^*(\theta+\eta)-1) - (\theta+\eta)]I^*(\lambda)$$

$$G''(1) = -\frac{2\lambda^2}{\delta}(S^{*'}(\delta)) - 2\left(1-I^*(\lambda)\right)\frac{\lambda}{\delta}(1-S^*(\delta)) - \frac{2\lambda^2}{\delta^2}(1-S^*(\delta))$$

$$T''(1) = [\lambda(1-S_w^*(\theta+\eta)+(\theta+\eta)][\frac{2\lambda^2}{\delta}(S^{*'}(\delta)) + \frac{2\lambda^2}{\delta^2}(1-S^*(\delta))] + 2\frac{\lambda}{\delta}(1-S^*(\delta))$$
$$[\frac{\lambda^2}{\theta+\eta}\left(1-S_w^*(\theta+\eta)\right) + \lambda^2(S_w^{*''}(\theta+\eta))] + \frac{2\lambda^3}{(\theta+\eta)^2}\left(1-S_w^*(\theta+\eta)\right) + \frac{2\lambda^3}{\theta+\eta}\left(S_w^{*'}(\theta+\eta)\right)$$

$$U''(1) = \frac{2\lambda^2}{\theta+\eta}\left(1-S_w^*(\theta+\eta)\right) - 2I^*(\lambda)\lambda^2(S_w^{*''}(\theta+\eta)) + \frac{2\lambda^3}{(\theta+\eta)^2}\left(1-S_w^*(\theta+\eta)\right) + \frac{2\lambda^3}{\theta+\eta}\left(S_w^{*'}(\theta+\eta)\right)$$

$$L_s = W_0 \frac{\begin{array}{c}\big(1-I^*(\lambda)\big)\lambda\delta^2(\theta+\eta)^2\mathrm{S}'(1)\big[2\mathrm{T}'(1)+\mathrm{T}''(1)\big]+\delta\lambda^2(\theta+\eta)^2\big(1-\mathrm{S}^*(\delta)\big)\\ \times\big[\mathrm{U}''(1)G'(1)-\mathrm{U}'(1)\mathrm{G}''(1)\big]+\lambda^2(\theta+\eta)\mathrm{U}'(1)\mathrm{G}'(1)\\ \times\big[\delta(\theta+\eta)\big(1-\mathrm{S}^*(\delta)\big)+\lambda\delta(\theta+\eta)\mathrm{S}^{*'}(\delta)+2\lambda(\theta+\eta)\big(1-\mathrm{S}^*(\delta)\big)+\lambda\delta\big(1-\mathrm{S}^*(\delta)\big)\big]\\ -\lambda\delta^2(\theta+\eta)^2\big(1-I^*(\lambda)\big)\mathrm{T}'(1)\mathrm{S}''(1)+\delta\lambda^3(1-S_w^*(\theta+\eta)(G'(1))^2\\ \times[\delta(\theta+\eta)+\lambda(\theta+\eta)+2\lambda\delta]+\lambda^4\delta^2(G'(1))^2\left(\mathrm{S}_{\mathrm{w}}^{*'}(\theta+\eta)\right)\end{array}}{2\lambda^2\delta^2(\theta+\eta)^2(G'(1))^2} \quad (39)$$

The mean number of customers in the orbit L_q under steady state condition is obtained by differentiating (31) with respect to z and put z = 1 , we get

$$L_q = C_0'(1) = \lim_{z\to 1}\frac{d}{dz}C_0(z)$$

$$L_q = W_0 \frac{\begin{array}{c}\big(1-I^*(\lambda)\big)\lambda\delta^2(\theta+\eta)^2\mathrm{S}'(1)\big[2\mathrm{T}'(1)+\mathrm{T}''(1)\big]+\delta\lambda^2(\theta+\eta)^2(1-\mathrm{S}^*(\delta))\\ \times\big[\mathrm{U}''(1)G'(1)-\mathrm{U}'(1)\mathrm{G}''(1)\big]+\lambda^2(\theta+\eta)\mathrm{U}'(1)\mathrm{G}'(1)\\ \times\big[\lambda\delta(\theta+\eta)\mathrm{S}^{*'}(\delta)+2\lambda(\theta+\eta)\big(1-\mathrm{S}^*(\delta)\big)+\lambda\delta\big(1-\mathrm{S}^*(\delta)\big)\big]\\ -\lambda\delta^2(\theta+\eta)^2\big(1-I^*(\lambda)\big)\mathrm{T}'(1)\mathrm{S}''(1)+\delta\lambda^3(1-S_w^*(\theta+\eta)(G'(1))^2\\ \times[\lambda(\theta+\eta)+2\lambda\delta]+\lambda^4\delta^2(G'(1))^2(\mathrm{S}_{\mathrm{w}}^{*'}(\theta+\eta))\end{array}}{2\lambda^2\delta^2(\theta+\eta)^2(G'(1))^2} \quad (40)$$

By Little's formula,

$$W_s = \frac{L_s}{\lambda}$$

$$W_s = W_0 \frac{\begin{array}{c}\big(1-I^*(\lambda)\big)\lambda\delta^2(\theta+\eta)^2\mathrm{S}'(1)\big[2\mathrm{T}'(1)+\mathrm{T}''(1)\big]+\delta\lambda^2(\theta+\eta)^2\big(1-\mathrm{S}^*(\delta)\big)\\ \times\big[\mathrm{U}''(1)G'(1)-\mathrm{U}'(1)\mathrm{G}''(1)\big]+\lambda^2(\theta+\eta)\mathrm{U}'(1)\mathrm{G}'(1)\\ \times\big[\delta(\theta+\eta)\big(1-\mathrm{S}^*(\delta)\big)+\lambda\delta(\theta+\eta)\mathrm{S}^{*'}(\delta)+2\lambda(\theta+\eta)\big(1-\mathrm{S}^*(\delta)\big)+\lambda\delta\big(1-\mathrm{S}^*(\delta)\big)\big]\\ -\lambda\delta^2(\theta+\eta)^2\big(1-I^*(\lambda)\big)\mathrm{T}'(1)\mathrm{S}''(1)+\delta\lambda^3(1-S_w^*(\theta+\eta)(G'(1))^2\\ \times[\delta(\theta+\eta)+\lambda(\theta+\eta)+2\lambda\delta]+\lambda^4\delta^2(G'(1))^2\left(\mathrm{S}_{\mathrm{w}}^{*'}(\theta+\eta)\right)\end{array}}{2\lambda^3\delta^2(\theta+\eta)^2(G'(1))^2} \quad (41)$$

$$W_q = \frac{L_q}{\lambda}$$

$$W_q = W_0 \frac{\begin{array}{c}\big(1-I^*(\lambda)\big)\lambda\delta^2(\theta+\eta)^2\mathrm{S}'(1)\big[2\mathrm{T}'(1)+\mathrm{T}''(1)\big]+\delta\lambda^2(\theta+\eta)^2\big(1-\mathrm{S}^*(\delta)\big)\\ \times\big[\mathrm{U}''(1)G'(1)-\mathrm{U}'(1)\mathrm{G}''(1)\big]+\lambda^2(\theta+\eta)\mathrm{U}'(1)\mathrm{G}'(1)\\ \times\big[\lambda\delta(\theta+\eta)\mathrm{S}^{*'}(\delta)+2\lambda(\theta+\eta)\big(1-\mathrm{S}^*(\delta)\big)+\lambda\delta\big(1-\mathrm{S}^*(\delta)\big)\big]\\ -\lambda\delta^2(\theta+\eta)^2\big(1-I^*(\lambda)\big)\mathrm{T}'(1)\mathrm{S}''(1)+\delta\lambda^3(1-S_w^*(\theta+\eta)(G'(1))^2\\ \times[\lambda(\theta+\eta)+2\lambda\delta]+\lambda^4\delta^2(G'(1))^2\left(\mathrm{S}_{\mathrm{w}}^{*'}(\theta+\eta)\right)\end{array}}{2\lambda^3\delta^2(\theta+\eta)^2(G'(1))^2} \quad (42)$$

The estimated lengths of the busy period and busy cycle are $E(T_b)$ and $E(T_c)$

$$P_0 = \frac{E(T_0)}{E(T_b)+E(T_0)}; E(T_b) = \frac{1}{\lambda}\left(\frac{1}{P_0} - 1\right); E(T_c) = \frac{1}{\lambda P_0} = E(T_b) + E(T_0) \quad (43)$$

$$E(T_0) = \frac{1}{\lambda}$$

$$E(T_b) = \frac{I^*(\lambda)+\frac{\lambda}{\theta+\eta}(1-S_w^*(\theta+\eta)) - \frac{\lambda}{\delta}(1-S^*(\delta))(1-S_w^*(\theta+\eta))+\frac{(\theta+\eta)}{\delta}(1-S^*(\delta))}{(\theta+\eta)\left\{I^*(\lambda)-\frac{\lambda}{\delta}(1-S^*(\delta))\right\}} \quad (44)$$

$$E(T_c) = \frac{I^*(\lambda)\left(\frac{\theta+\eta}{\lambda}+1\right)+\frac{\lambda}{\theta+\eta}(1-S_w^*(\theta+\eta)) - \frac{\lambda}{\delta}S_w^*(\theta+\eta)(1-S^*(\delta))}{(\theta+\eta)\{I^*(\lambda)-\frac{\lambda}{\delta}(1-S^*(\delta))\}} \quad (45)$$

Particular cases

Case(i)
No negative customer, No repair
Allowing for $(\delta = \eta = 0)$ this approaches cut down to
$M/G/1$ Retrial queue with working vacation and vacation interruption

Case(ii)
No negative customer, No repair, no vacation
Allowing for $(\delta = \eta = \theta = 0)$ this approaches cut down to
$M/G/1$ Retrial queue

NUMERICAL EXAMPLES

By fixing the values of, μ = 10 , μ w = 8 , θ = 0.9 , δ = 0.8 and extending the value of λ from 1 to 2 incremented with 0.2 and extending the values of η from 0.5 to 4.5 insteps of 2 the values of Ls are calculated and tabulated in Table 1 and the corresponding line graphs are drawn in the Figure 1 . From the graph it is inferred that as λ rises Ls rises as expected.

By fixing the values of, μ = 12 , μw = 10 , θ = 0.4 , δ = 0.7 and extending the value of λ from 1 to 2 incremented with 0.2 and extending the values of η from 0.5 to 4.5 insteps of 2 the values of Lq are calculated and tabulated in Table 2 and the corresponding line graphs are drawn in the Figure 2 . From the graph it is inferred that as λ rises Lq rises as expected.

By fixing the values of, μ = 10 , μw = 8 , θ = 0.9 , δ = 0.8 and extending the value of λ from 1 to 2 incremented with 0.2 and extending the values of η from 0.5 to 4.5 insteps of 2 the values of Ws are calculated and tabulated in Table 3 and the corresponding line graphs are drawn in the Figure 3 . From the graph it is inferred that as λ rises Ws rises as expected.

By fixing the values of, μ = 12 , μw = 10 , θ = 0.4 , δ = 0.7 and extending the value of λ from 1 to 2 incremented with 0.2 and extending the values of η from 0.5 to 2.5 insteps of 1 the values of Wq are calculated and tabulated in Table 4 and the corresponding line graphs are drawn in the Figure 4 . From the graph it is inferred that as λ rises Wq rises as expected.

CONCLUSION

A Non Markovian single server retrial G- queue with WB and WC is evaluated in this paper. We obtain the PGF for system size and orbit size, using the approach of supplementary variable technique. We derive the performance measures. We perform some particular cases. We illustrate some numerical results.

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Table 1. λ **rises** L_s **rises**

λ	η=0.5	η=2.5	η=4.5
1.0	0.1254	0.1375	0.1451
1.2	0.1759	0.2002	0.2168
1.4	0.2392	0.2840	0.3165
1.6	0.3177	0.3948	0.4533
1.8	0.4142	0.5393	0.6379
2.0	0.5315	0.7246	0.8825

Table 2. λ **rises** L_q **rises**

λ	η=0.5	η=2.5	η=4.5
1.0	0.1296	0.0895	0.0798
1.2	0.1892	0.1311	0.1164
1.4	0.2605	0.1811	0.1603
1.6	0.3434	0.2398	0.2119
1.8	0.4383	0.3073	0.2713
2.0	0.5450	0.3840	0.3387

Table 3. λ **rises** W_s **rises**

λ	η=0.5	η=2.5	η=4.5
1.0	0.1254	0.1375	0.1451
1.2	0.1466	0.1668	0.1807
1.4	0.1708	0.2029	0.2261
1.6	0.1986	0.2468	0.2833
1.8	0.2301	0.2996	0.3544
2.0	0.2657	0.3623	0.4412

Table 4. λ **rises** W_q **rises**

λ	η=0.5	η=1.5	η=2.5
1.0	0.1296	0.1017	0.0895
1.2	0.1577	0.1242	0.1092
1.4	0.1860	0.1472	0.1293
1.6	0.2146	0.1706	0.1498
1.8	0.2435	0.1943	0.1707
2.0	0.2725	0.2183	0.1920

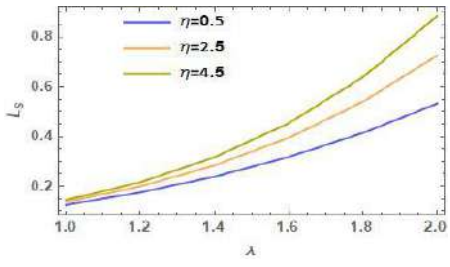

Figure 1. λ **rises** L_s **rises**

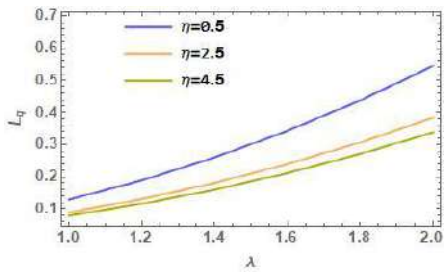

Figure 2. λ **rises** L_q **rises**

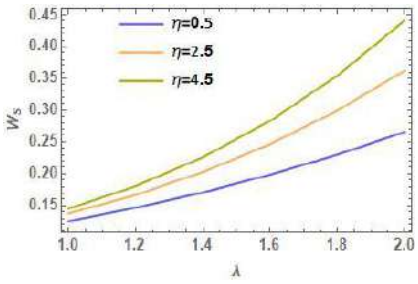

Figure 3. λ **rises** W_S **rises**

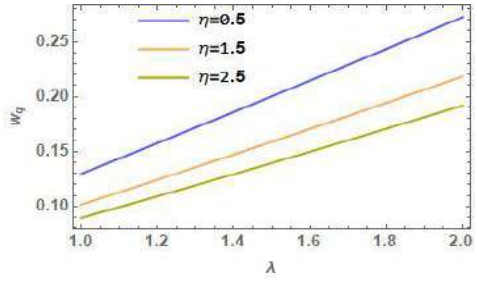

Figure 4.λ **rises** W_q **rises**

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RESEARCH ARTICLE

Organic Practices for the Cultivation of Traditional Rice Variety Poongar

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ABSTRACT

Field experiment was carried out during Feb-May, 2018 at Mothakkal village, Vellore district, Tamil Nadu, to study the effect of organic seed treatment and foliar nutrient for the growth and yield of traditional rice variety. The experiment was laid out in split plot design with three replications. The main plot consists of three treatments *viz.,* M_1 - FYM @ 12.5t ha^{-1}+3% *Panchagavya* + 3% *Jeevamirtham,* M_2 - Goat manure @ *6.5t* ha^{-1} +3% *Panchagavya* + 3% *Jeevamirtham,* M_3 - Vermicompost @ *5t* ha^{-1}+3% *Panchagavya* + 3% *Jeevamirtham.* The sub-plot comprised five treatments *viz.,* S_1 - Seed treatment with Cow dung solution, S_2 -Seed treatment with Goat dung solution, S_3 - Seed treatment with *Azospirillium,* S_4 - Seed treatment with *Phosphobacteria,* S_5 - control (No Seed treatment) *(Panchagavya* and *Jeevamirtham* applied on *15,30 and 45* DAT. Among the main treatment, Vermicompost @ *5t* ha^{-1} +3% *Panchagavya* + 3% *Jeevamirtham* influence the growth and yield components such as plant height, number oftillers hill1 leaf area index, dry matter production, panicle number of filled grains, grain, yield, straw yield. Among the sub-treatment, S_3- Seed treatment with *Azospirillium* recorded the maximum growth and yield parameters as well as grain and straw yield. This was followed by S_4- Seed treatment with *Phosphobacteria.* The study revealed that the M_3- Vermicompost 5*t* ha^{-1}+ 3% *Panchagavya* + 3% *Jeevamirtham* with seed treatment with *Azospirillium* (S_3) significantly recorded the highest grain yield of and straw yield of the N, P and K uptake was also maximum in the above said combination (M_3S_3). This treatment also resulted in the highest net return and return $rupee^{-1}$ invested in the trails.

Keywords: Traditional Rice, Poongar, organic seed treatment, foliar nutrient.

INTRODUCTION

Rice (Oryza sativa L.) is the major staple food for more than half of the global population and its supplies 50 to 80 percent calories of energy and hence, considered as the "global grain". At the global level, rice is grown in an area of about 161.35 million hectares with production and productivity of 480.13 million metric tonnes and 4.4 t ha-1 respectively. Rice cultivation in India is based on the monsoon, at present monsoon in India has become increasingly unproductive and erratic in recent times, modern studies have indicated that changing climate will decrease the yield in major crops and crop like rice are adversely affected due to monsoon failures. To overcome the risks of drought and floods it is imperative need to cultivate traditional cultivars with traditional methods which are able to withstand aberrant weather condition to some extent. The traditional technologies are nothing but indigenous technical knowledge by adopting organic practices. It is the systematic body of knowledge acquired by local people through the accumulation of experience, internal experiments and intimate understanding of environment in a given culture. After the green revolution, the introduction of modern varieties and adaptation of modern cultivation techniques which are practised by the farmers for past years are resulted in degradation of land and environment pollution. In order to sustain the soil and crop it is an imperative need to grow traditional varieties in traditional methods.

MATERIALS AND METHODS

The study was conducted in the Mothakkal village, Vellore district, Tamil Nadu during Feb - May, 2018 to study the effect of seed treatment and organic foliar nutrition on the growth and yield of traditional rice variety (poongar). The experimental plot is situated at 12°92' N latitude and 79°13' E longitude with an altitude of 220 m above mean sea level. The mean annual rainfall at Vellore is 1034.l mm distributed over 60 rainy days. Out of total rainfall, 388.4 mm is received during North East monsoon (October - December), 517.l mm received during South West monsoon (June - September) and 128.6 mm during the hot weather period as summer showers. The maximum temperature fluctuates between 39.4°C and 28°C with a mean of 35°C, while minimum temperature ranges between 23.3°C and 21.5°C with a mean of 25.92°C. The humidity ranges from 40o/o-63% during summer and 67%-86% during winter. The soil is classified as Sandy Clay Loam in texture with low in available nitrogen, high in available phosphorus and medium in available potassium. The crop was raised during late sornavari season of 2018-2019 (Feb) with traditional rice of Poongar. The experiment was laid out in Split-Plot Design (SPD) with three replications. The treatments were M1 – FYM @ 12.5/t ha-1 + 3% Panchagavya + 3% Jeevamirtham, M2 - Goat manure @ 6.5t ha-1+ 3%Panchagavya + 3% Jeevamirtham, M3 - Vermicompost @ 5t ha-1+ 3% Panchagavya + 3% Jeevamirtham, S1 - Seed treatment with cow dung solution, S2 - Seed treatment with goat dung solution, S3 - Seed treatment with Azospirillium, S4 - Seed treatment with Phosphobacteria, S5 - control (without seed treatment) (Panchagavya and Jeevamirtham applied on 15,30 and 45 DAT).

RESULTS AND DISCUSSION

Growth parameters

Result of the field experiment revealed that vermicompost 5t ha-1+ 3 percent panchagavya + 3 percent jeevamirtham along with seed treatment using *Azospirillium* exhibited a salutary effect which was evident in terms of growth of traditional rice variety ..,. viz., plant height, number of tillers, LAI and DMP. The reason might be the fact that younger seedlings in this treatment had higher vigour, more root length and less transplant shock during the initial growth stages which stimulated plant height. Similar findings were reported by Viridia and Metha (2010). The transplanting Shock was higher in organic manure, FYM applied plots, which might be the reason for reduced plant height. Nitrogen is the primary element for growth of crop which is responsible for developing good vegetative frame. Nitrogen as a constituent of protein is associated with the activity of every living cell. Thus, there was vigorous growth of aerial organs due to high rate of synthesis of protoplasmic protein which increased cell size within cell wall and was finally, responsible for greater vertical development in height of the plant. The amounts of

soil nitrogen increased significantly after incorporating vermicompost into the soils. These results are presently conformity with the finds of Sreenivas et al, 2000 and the amounts of P and K is also increased. The incorporation of earthworm cast improved the plant growth, leaf growth and root length. In addition vermicompost contains a considerable amount of micronutrients (Amanullah, 2016), humic acid (Maji et al.,) and growth stimulators like auxins, gibberellins, and cytokinins and phosphate, enzyme, and vitamin dissolving bacteria (Liu et al., 2017). These compounds improve leaf area, tiller number and finally, biological yield (Joshi et al., 2015). Chemolitho autotropic nitrifiers (ammonifers and nitrifers) present in panchagavya which colonize in the leaves increases the ammonia uptake and enhances the total N supply. Smaller quantities of IAA and GA present in panchagavya , when foliar sprayed could have created stimuli in the plant system which in turn increased the production of growth regulator in cell system, whereas the action of growth regulators in plant system stimulated the necessary growth and development of plants. Seedlings inoculated with *Azospirillum* sp. also significantly increased growth in terms of tiller numbers and shoot length in paddy crop.

Application of vermicompost 5t ha-1+ 3 percent panchagavya + 3 percent jeevam irtham registered the maximum LAI than others. The reason might be that this combination enhanced the rice growth and plant had more open architecture, with tillers spread out more widely. Also covering more ground area and more erect leaves that avoided mutual shading of leaves by supplying essential plant nutrients released by them. These resulted in higher leaf area index due to significant increase in leaf size and there by increased LAI. The maximum number of tillers hill was registered in the treatment M3S3- Vermicompost 5t ha-1+ 3 percent Panchagavya +3 percent Jeevamirtham in combination with seed treatment using *Azospirillium*. With regard to dry matter production of rice, the highest DMP was registered with the treatment, M3S3-vermicompost 5t ha-1+ 3 percent panchagavya + 3 percent jeevamirtham along with seed treatment using Azospirillium. This was followed by the treatment, M3S4- vermicompost 5t ha-1+ 3 percent panchagavya + 3 percent jeevamirtham along with seed treatment with Phosphobacteria respectively. Vermicompost also contains different growth promoting substances which induced high dry matter yield leading to higher uptake of nutrients. Presence of growth enzyme in panchagavya favoured rapid cell division and multiplication which resulted in higher dry matter production.

Yield Components And Yield

The yield potential of rice is determined by yield components and the values of yield components are generally in accordance with that of growth parameters. This was well reflected in the present investigation also. Among the yield parameters, productive tillers•' and number of filled grains panicle- 1 were greatly influenced by rice in respect to the application of vermicompost 5t ha-1+ 3 percent panchagavya + 3 percent jeevamirtham along with seed treatment using *Azospirillium*. As it is mainly governed by the genetic character of the cultivar, test weight was not influenced by different organic sources (Sa). The maximum number of panicle-1, percent of filled grains, grain yield, and straw yield was recorded in traditional variety receiving through verrnicompost 5t ha-1 + panchagavya. These results are presently conformity with the finds of Rajeshwaran (2018) in traditional Kuzhiydichan variety. The easytran nutrient and growth stimulants to plants through foliar spray of optimum dose of panchagavya might be the reason for enhancement in the yield attributes. Panchagavya extends stimulatory effect to plant through phytohormones AA, GA3, Cytokinin. Foliar application of panchagavya and jeevamirtham had increased the yield in rice. Sattar et al. (2014) also reported that the inoculation of azospirillum bio fertilizer recorded maximum yield among the treatments as compared to where the bio fertilizer was not used. The lowest grain yield was recorded under M1S5-Farm yard manure (FYM) 12.5t ha-1+ 3 percent panchagavya + 3 percent jeevamirtham without any seed treatment. This might be due to the low availability of nutrients and without seed treatment. Field experiment was carried out during Feb-May 2018 at Mothakkal village, Vellore district, Tamilnadu, the following conclusion are drawn. The higher grain yield and straw yield gave under the manorial treatment of M3S3- Vermicompost @ 5t ha-1 + 3 percent Panchagavya + 3 percent Jeevamirtham with Seed treatment with *Azospirillium*. Among the tested treatment of M3S3 - Vermicompost@5t ha-1+3 percent Panchagavya + 3 percent Jeevamirtham with Seed treatment with Azospirillium gave the higher Net return and Benefit cost ratio. From the field experiment application of organic source of nutrient always increased the yield in a sustainable way without affecting the soil health.

CONCLUSION

Field experiment was carried out during Feb-May 2018 at Mothakkal village, Vellore district, Tamil Nadu, the following conclusion are drawn. The higher grain yield and straw yield gave under the manural treatment of M3S3 - Vermicompost @ 5t/ha-1+3 percent Panchagavya +3 percent Jeevamirtham with Seed treatment with *Azospirillium*. Among the tested treatment of M3S3–Vermicompost@ 5t ha-1+3 percent Panchagavya + 3 percent Jeevamirtham with Seed treatment with *Azospirillium* gave the higher Net return and Benefit cost ratio. From the field experiment application of organic source of nutrient always increased the yield in a sustainable way without affecting the soil health.

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Table 1: Effect of seed treatment and organic foliar nutrition on the plant height, Number of tillers at harvest stage, LAI and Dry matter production kgha^{-1} of traditional rice (poongar)

Treatments	Plant height at harvesting stage (cm)	Number of tillers at harvest stage	LAI	Dry matter production kgha^{-1}
Main Plot Treatments				
M_1	115.44	297.09	4435	6.97
M_2	120.85	314.36	4876	7.26
M_3	120.85	330.46	5271	7.67
S.Ed	0.68	1.68	32.03	0.04
CD (p=0.05)	1.89	4.68	88.93	0.11
Sub Plot Treatments				
S1	111.40	13.41	6.81	4434
S2	116.84	14.27	7.12	4684
S3	141.52	16.52	8.35	5984

S4	137.67	16.30	8.12	5785
S5	99.46	9.57	6.11	3417
S.Ed	2.61	0.26	0.16	119.92
CD(p=0.05	5.51	0.55	0.34	247.51

Table 2: Effect of seed treatment and organic foliar nutrition on number of productive tillers m², Grain yield kg ha⁻¹, Straw yield kg ha⁻¹ in traditional rice variety (Poongar)

Treatments	Number of productive tillers m²	Grain yield kg ha-1	Straw yield kg ha-1
Main Plot Treatments			
M_1	297.09	1750	3373
M_2	314.36	1990	3585
M_3	330.46	2357	3826
S.Ed	1.68	18.26	21.26
CD (p=0.05)	4.68	50.72	59.11
Sub Plot Treatments			
S1	295.18	1650	3457
S2	305.47	1819	3583
S3	362.18	2816	4183
S4	351.84	2668	4062
S5	255.16	1210	2692
S.Ed	7.33	56.05	84.45
CD (p=0.05)	15.13	115.69	174.29

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RESEARCH ARTICLE

Reduced Neighborhood Topological Indices and RNM-Polynomial of Hyaluronic Acid-Curcumin Conjugates

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ABSTRACT

Quantitative structure-activity relationship (QSAR) represents quantitative correlation of chemical structural features called as molecular descriptors and pharmacological activity as response endpoints. Topological index is a molecular descriptor extensively used QSAR of pharmaceuticals to assess their molecular characteristics by numerical computation. Theoretical assessment of drug like molecules helps to expedite the drug design and discovery process by rationalizing thee lead identification, lead optimization and understanding their mechanism of actions. Therefore, in this article, we have computed the reduced neighborhood topological indices of Hyaluronic acid-curcumin conjugates by using molecular structure analysis and edge partitioning technique. We also proposed RNM-Polynomial of Hyaluronic acid-curcumin conjugates from which many well-known polynomials are deduced.

Keywords: Degree-based topological polynomials, Hyaluronic acid-curcumin conjugates, reduced topological indices.

INTRODUCTION

The computation of degree-based indices and distance-based indices for special molecular drug structures has raised considerable interest among medical and pharmaceutical researchers as it is useful to make up the medicinal and chemical experimental defects. Gao W et al. in [3] have theoretically analyzed and obtained several degree-based topological indices of doxorubicin loaded micelle consisting of PEG-pAsp block co-polymer with chemically

conjugated doxorubicin, while many multiplicative topological indices for the same molecularstructure have recently been derived [8]. The forgotten topological index of some important drug structures has been manifested in [4]. The first multiplicative atom-bond connectivity index of critical drug structures, like alkene, cycloalkenes, dendrimers, benzenoid systems, and phenylenes were analyzed by the researchers in [5]. Weiner related indices for coronoid and kekulenes structures were reportedby [1]. Very recently, several topological indices of COVID-19 based drugs such as remdesivir, chloroquine, hydroxychloroquine and the a flavin have been investigated [6]. In addition, [9] computed topological indices of hyaluronic acid, which is thoroughly investigated in cancer therapy because of its excellent physical features. Curcumin, also known as diferuloylmethane or 1,7- bis(4-hydr oxy-3-methoxyphenyl)-1, 6-heptadiene-3,5-dione, is an orange-yellow polyphenolic compound, extracted from the rhizome of Curcuma longa. Since ancient times, it is known to be endowed with remarkable medicinal properties against a range of ailing conditions suchas inflammation, cancer, diabetes, neurodegenerative disorders, cardiovascular diseases and asthma.

It is well tolerated in humans and safety doses of curcumin were noted to beas high as 8 g/day. Unfortunately, poor aqueous-solubility of curcumin leads to inadequate bio-availability in biological systems which is a major obstacle limiting its clinical utility. In particular, conjugation of curcumin with hyaluronic acid has received appreciable attention in recent times not only for increasing bio-availability but also to target tumor cells and tumor metastases for the treatment of numerous cancers. Hyaluronic acid (HA) is a nontoxic, non-immunogenic, bio-compatible and biodegradable glycosaminoglycan polymer which is widely distributed in the human body throughout extracellular matrix, articular cartilage, bone marrow and synovial fluids. It is a linear polymer composed of repeating units of b-1,4-D-glucuronic acid and b-1,3-N- acetyl-glucosamine. The abundance of carboxylic and hydroxyl groups in its structure confer great potential as a drug carrier owing to its unique physicochemical as well as biological properties. The cluster of differentiation 44 (CD44) proteins is regarded as the main receptor of HA, which is activated upon interaction with HA and influence many signalingpathways involved in inflammation, wound healing, morphogenesis and cancer. Moreover,it is reported to be over- expressed in the tumor microenvironment, and hence, offers great potential for tumor targeting. In pharmaceutical field, HA is well recognized as visco-supplementation therapy in which it is injected into the knee to enhance the viscosity of the synovial fluids that helps cushion and lubricate the joint. It is also used as ophthalmic biomaterial in several kinds of eye surgeries such as retinal detachment repairing, cataract surgery and corneal transplantation.

The HA-curcumin conjugate was reported to alleviate the fibrotic functions of myofibroblasts, rationalizing its use in the treatmentof joint contracture. These conjugates have also been reported to increase the aqueous solubility of curcumin to 7.5 mg/ml, which is equivalent of 265 μM of curcumin. Therefore, conjugates of curcumin with HA is regarded as promising pharmaceutical strategy to improve water solubility, prolong curcumin release at the target site, improve tissue distribution and potentiate therapeutic outcomes. Zheng L et al. in [10] computed many degree-based topological indices and polynomials of HA- paclitaxel as paclitaxel is well known drug for its anticancer properties. However, paclitaxel has some side effects such as neurotoxicity, hepatotoxicity, cardio-toxicity etc., demanding innovative approaches to avoid these issues. Ashrafizadeh M et al. in [2] demonstrated that curcumin is able to suppress paclitaxel resistance and attenuate its side effects. Parvez Ali *et al*. in [7] computed some degree-based topological indices and polynomials of hyaluronic acid-curcumin conjugates. Thus, due to the enormous pharmaceutical interests of HA- curcumin conjugates, current research seeks to investigate degree-based topological indices and polynomials of the molecular structure of HA-curcumin conjugates. The outcomes of the current findings will enable researchers to have a better understanding of the physicochemical properties and pharmacological characteristics of HA-curcumin conjugates. In addition, these results may provide a theoretical foundation for pharmaceutical engineering.

MAIN RESULT AND DISCUSSION

In this section we give some definitions for some reduced neighborhood topological indices and RNM-polynomial.

2.1. Reduced neighborhood topological indices and RNM-polynomial

The types of reduced neighborhood indices were defined as follows

Definition 2.1

Let $G = (V, E)$ be a simple graph. Then for each vertex $v \in V$, the open neighborhood of $v, N(v)$, is the set of all vertices $u \neq v$ in $V(G)$ which are adjacent to v.

Definition 2.2

Let $G = (V, E)$ be a simple graph with $|V(G)| = n$ and $|E(G)| = m$. The N - degree of a vertex $u \in V$ is defined as the sum of the degree of the vertices in the open neighborhoodof u. That is,

$$d_N(u) = \sum_{v \in N(u)} d(v)$$

The reduced neighborhood degree of a vertex $u \in V$ is defined as

$$d_{N'}(u) = \sum_{v \in N(u)} (d(v) - 1)$$

The maximum degree $\Delta'_N(G)$ is defined as $\Delta'_N = max\{d_{N'}(v): v \in V(G)\}$

The minimum degree $\ddot{a}'_N(G)$ is defined as $\ddot{a}'_N = min\{d_{N'}(v): v \in V(G)\}$.

Definition 2.3

Let $G = (V, E)$ be a simple graph with $|V(G)| = n$ and $|E(G)| = m$. Then the reduced neighborhood first Zagreb index and second Zagreb index, denoted by $RNM_1(G)$ and $RNM_2(G)$ respectively, are defined as

$$RNM_1(G) = \sum_{u \in v(G)} d_{N'}(u)^2$$

$$RNM_2(G) = \sum_{uv \in E(G)} d_{N'}(u) d_{N'}(v)$$

Definition 2.4

We define the modified reduced neighborhood version of the first Zagreb index, denoted by$RNM_1^*(G)$, as follows

$$RNM_1^*(G) = \sum_{uv \in E(G)} [d_{N'}(u) + d_{N'}(v)]$$

Definition 2.5

Let $G = (V, E)$ be a simple graph with $|V(G)| = n$ and $|E(G)| = m$. Then the forgotten reduced neighborhood index, denoted by $RNM_3(G)$, is defined as

$$RNM_3(G) = \sum_{u \in V(G)} d_{N'}(u)^3$$

Definition 2.6

We define the modified, reduced neighborhood version of the forgotten topological index, denoted by $RNM_3^*(G)$, as follows:

$$RNM_3^*(G) = \sum_{uv \in E(G)} [d_{N'}(u)^2 + d_{N'}(v)^2]$$

Definition 2.7

Let $G = (V, E)$ be a simple graph with $|V(G)| = n$ and $|E(G)| = m$.

Then the hyper reduced neighborhood index, denoted by $HRN(G)$, is defined as

$HRN(G) = \sum_{uv \in E(G)} \left[d_{N'}(u) + d_{N'}(v)\right]^2$

Definition 2.8

Let the edge partition of the graph G be defined as
$R_{(i,j)}(G) = \{uv \in E(G): d_{N'}(u) = i \text{ and } d_{N'}(v) = j\}$

Definition 2.9

Let G be a graph and let$R_{(i,j)}(G), i, j \geq 1$, be the edge partition as defined in Definition 2.8 and let$R'_{ij} = |R_{(i,j)}|$. We introduce the RNM-polynomial of a graph G as

$$RNM(G,x,y) = \sum_{\delta'_N \leq i \leq j \leq \Delta'_N} R'_{ij}\, x^i y^j$$

3. The reduced neighborhood topological indices and RNM-polynomial for HA-curcumin conjugates G_n: $n = 1$.

In this section we calculate The reduced neighborhood topological indices and RNM-polynomial for HA-curcumin conjugates $Gn: n = 1$. Let G be a molecular graph of HA-curcumin conjugates G_n: n = 1. The graph G has 53 vertices and 56 edges.

Theorem 3.1: Let G be the molecular graph of HA-curcumin conjugates, $G_n: n = 1$, then

$$RNM(G,x,y) = 4x^2y^3 + 7x^3y^4 + 8x^2y^4 + 6xy^2 + 10x^3y^3 + 10x^4y^4 + 2x^2y^2 + x^3y^5 + x^5y^5 + 5x^4y^5 + x^2y^5 + xy^4$$

Proof: Let $R_{(i,j)}$ be the set of different types of edges as defined and let $R'_{ij} = |R_{(i,j)}|$. From Figure 3., it can be calculated that

$R'_{23} = 4, R'_{34} = 7, R'_{24} = 8, R'_{12} = 6, R'_{33} = 10, R'_{44} = 10, R'_{22} = 2, R'_{35} = 1, R'_{55} = 1, R'_{45} = 5, R'_{25} = 1, R'_{14} = 1.$

The RNM polynomial of G is obtained as follows:

$$RNM(G,x,y) = \sum_{\delta'_N \leq i \leq i \leq \Delta'_N} R'_{ij}\, x^i y^j$$

$$= R'_{23}x^2y^3 + R'_{34}x^3y^4 + R'_{24}x^2y^4 + R'_{12}xy^2 + R'_{33}x^3y^3 + R'_{44}x^4y^4 + R'_{22}x^2y^2 + R'_{35}x^3y^5 + R'_{55}x^5y^5 + R'_{45}x^4y^5 + R'_{25}x^2y^5 + R'_{14}xy^4$$
$$= 4x^2y^3 + 7x^3y^4 + 8x^2y^4 + 6xy^2 + 10x^3y^3 + 10x^4y^4 + 2x^2y^2 + x^3y^5 + x^5y^5 + 5x^4y^5 + x^2y^5 + xy^4$$

Theorem 3.2:

Let G be a molecular graph of curcumin-hyaluronic acid conjugates $G_n: n = 1$. Then

$RNM_1(G) = 522, RNM_2(G) = 596, RNM_3(G) = 1902, HRN(G) = 2460, \quad RNM_1^*(G) = 358, RNM_3^*(G) = 1268.$

Proof: The reduced neighborhood vertex degrees of $G_n: n = 1$ are listed in Table 1.

Using the Definitions 2.3, 2.5 and Table.1, we have

$$RNM_1(G) = \sum_{u \in v(G)} d_{N'}(u)^2$$

$= 5.1^2 + 15.2^2 + 14.3^2 + 16.4^2 + 3.5^2$

$= 522$

$$RNM_3(G) = \sum_{u \in V(G)} d_{N'}(u)^3$$

$= 5.1^3 + 15.2^3 + 14.3^3 + 16.4^3 + 3.5^3$

$= 1902$

Using the edge partition values of Theorem 3.1, we have

$RNM_2(G) = \sum_{uv \in E(G)} d_{N'}(u) d_{N'}(v)$

= 4(2.3) + 7(3.4) + 8(2.4) + 6(1.2) + 10(3.3) + 10(4.4) + 2(2.2) + 1(3.5) + 1(5.5)+5(4.5) + 1(2.5) + 1(1.4)

= 596

$$RNM_1^*(G) = \sum_{uv \in E(G)} \left[d_{N'}(u) + d_{N'}(v)\right]$$

= 4(2 + 3) + 7(3 + 4) + 8(2 + 4) + 6(1 + 2) + 10(3 + 3) + 10(4 + 4) + 2(2 + 2)+1(3 + 5) + 1(5 + 5) + 5(4 + 5) + 1(2 + 5) + 1(1 + 4)

= 4(5) + 7(7) + 8(6) + 6(3) + 10(6) + 10(8) + 2(4) + 1(8) + 1(10) + 5(9) + 1(7)+1(5)

= 358

$$HRN(G) = \sum_{uv \in E(G)} \left[d_{N'}(u) + d_{N'}(v)\right]^2$$

= 4(2 + 3)² + 7(3 + 4)² + 8(2 + 4)² + 6(1 + 2)² + 10(3 + 3)² + 10(4 + 4)² + 2(2 + 2)²+1(3 + 5)² + 1(5 + 5)² + 5(4 + 5)² + 1(2 + 5)² + 1(1 + 4)²

= 4(5)² + 7(7)² + 8(6)² + 6(3)² + 10(6)² + 10(8)² + 2(4)² + 1(8)² + 1(10)² + 5(9)²+1(7)² +1(5)²

= 2460

$$RNM_3^*(G) = \sum_{uv \in E(G)} \left[d_{N'}(u)^2 + d_{N'}(v)^2\right]$$

= 4(2² + 3²) + 7(3² + 4²) + 8(2² + 4²) + 6(1² + 2²) + 10(3² + 3²) + 10(4² + 4²)+2(2² + 2²) + 1(3² + 5²) + 1(5² + 5²) + 5(4² + 5²) + 1(2² + 5²) + 1(1² + 4²)

= 4(13) + 7(25) + 8(20) + 6(5) + 10(18) + 10(32) + 2(8) + 1(34) + 1(50)+5(41) + 1(29) + 1(17)

= 1268.

4. The reduced neighborhood topological indices and *RNM*- polynomial for HA-curcumin conjugates G_n.

Theorem 4.1: Let G_n be the molecular graph of HA-curcumin conjugates, then the RNM Polynomial can be given as, $RNM(G, x, y) = 4nx^2y^3 + 7nx^3y^4 + 8nx^2y^4 + (5n + 1)xy^2 + 10nx^3y^3 + (11n - 1)x^4y^4 + 2nx^2y^2 + nx^3y^5 + nx^5y^5 + (6n - 1)x^4y^5 + x^2y^5 + nxy^4$.

Proof: Let $R_{(i,j)}$ be the set of different types of edges as defined and let $R_{ij}^{'} = \left|R_{(i,j)}\right|$.

These edge sets $R_{ij}^{'} = \left|R_{(i,j)}\right|$of G_n are divided into twelve edge groups and is denoted by $E_i(G_n)$,where $1 \leq i \leq 12$, which implies $R_{ij}^{'} = \left|R_{(i,j)}\right| = |E_i(G_n)|$, based on the reduced neighborhood degrees of the end vertices. So, we write:

$$E(G_n) = \bigcup_{i=1}^{12} E_i(G_n), where$$

$E_1(G_n) = \{e = uv \in E(G_n): d_{N'}(u) = 2 \text{ and } d_{N'}(v) = 3\}$
$E_2(G_n) = \{e = uv \in E(G_n): d_{N'}(u) = 3 \text{ and } d_{N'}(v) = 4\}$
$E_3(G_n) = \{e = uv \in E(G_n): d_{N'}(u) = 2 \text{ and } d_{N'}(v) = 4\}$
$E_4(G_n) = \{e = uv \in E(G_n): d_{N'}(u) = 1 \text{ and } d_{N'}(v) = 2\}$
$E_5(G_n) = \{e = uv \in E(G_n): d_{N'}(u) = 3 \text{ and } d_{N'}(v) = 3\}$
$E_6(G_n) = \{e = uv \in E(G_n): d_{N'}(u) = 4 \text{ and } d_{N'}(v) = 4\}$
$E_7(G_n) = \{e = uv \in E(G_n): d_{N'}(u) = 2 \text{ and } d_{N'}(v) = 2\}$
$E_8(G_n) = \{e = uv \in E(G_n): d_{N'}(u) = 3 \text{ and } d_{N'}(v) = 5\}$
$E_9(G_n) = \{e = uv \in E(G_n): d_{N'}(u) = 5 \text{ and } d_{N'}(v) = 5\}$
$E_{10}(G_n) = \{e = uv \in E(G_n): d_{N'}(u) = 4 \text{ and } d_{N'}(v) = 5\}$
$E_{11}(G_n) = \{e = uv \in E(G_n): d_{N'}(u) = 2 \text{ and } d_{N'}(v) = 5\}$

$E_{12}(G_n) = \{e = uv \in E(G_n): d_{N'}(u) = 1 \text{ and } d_{N'}(v) = 4\}$

Therefore, by the graph structure analysis and observation, we note that,

$|E_1(G_n)| = 4n, |E_2(G_n)| = 7n, |E_3(G_n)| = 8n, |E_4(G_n)| = (5n+1), |E_5(G_n)| = 10n,$
$|E_6(G_n)| = (11n-1), |E_7(G_n)| = 2n, |E_8(G_n)| = n, |E_9(G_n)| = n, |E_{10}(G_n)| = (6n-1), |E_{11}(G_n)| = 1, |E_{12}(G_n)| = n.$

From Figure 4, the RNM polynomial of G can be obtained as follows:

$$RNM(G,x,y) = \sum_{\ddot{a}'_N \le i \le j \le \Delta'_N} R'_{ij}\, x^i y^j$$

$$= R'_{23}x^2y^3 + R'_{34}x^3y^4 + R'_{24}x^2y^4 + R'_{12}xy^2 + R'_{33}x^3y^3 + R'_{44}x^4y^4 + R'_{22}x^2y^2 + R'_{35}x^3y^5 +$$

$R'_{55}x^5y^5 + R'_{45}x^4y^5 + R'_{25}x^2y^5 + R'_{14}xy^4$
$= 4nx^2y^3 + 7nx^3y^4 + 8nx^2y^4 + (5n+1)xy^2 + 10nx^3y^3 + (11n-1)x^4y^4 + 2nx^2y^2\, nx^3y^5 + nx^5y^5 + (6n-1)x^4y^5 + x^2y^5 + nxy^4.$

Theorem 4.2: Let G_n be the molecular graph of HA-curcumin conjugates, then the general reduced topological indices can be given as,

$RNM_1(G) = 540n - 18, RNM_2(G) = 620\text{n} - 24, RNM_3(G) = 1994n - 92,$
$HRN(G) = 2547n - 87, RNM_1^*(G) = 365n - 7, RNM_3^*(G) = 1307n - 39.$

Proof: The vertex sets of G_n can be divided into five vertex groups, based on the reduced neighborhood vertex degrees, which can be written as

$$V(G_n) = \bigcup_{i=1}^{12} V_i(G_n), where$$
$V_1(G_n) = \{u \in V(G_n): d_{N'}(u) = 1\}$
$V_2(G_n) = \{u \in V(G_n): d_{N'}(u) = 2\}$
$V_3(G_n) = \{u \in V(G_n): d_{N'}(u) = 3\}$
$V_4(G_n) = \{u \in V(G_n): d_{N'}(u) = 4\}$
$V_5(G_n) = \{u \in V(G_n): d_{N'}(u) = 5\}$

$$RNM_1(G) = \sum_{u \in v(G)} d_{N'}(u)^2$$

= (4n+1).1^2 + (14n+1).2^2 + (13n+1).3^2 + (18n-2).4^2 + 3n.5^2

= 540n-18

$$RNM_3(G) = \sum_{u \in V(G)} d_{N'}(u)^3$$

= (4n+1).1^3 + (14n+1).2^3 +(13n+1) .3^3 + (18n-2).4^3 + 3n.5^3

= 1994n-92

Using the edge partition values of Theorem 4.1, we can calculate

$$RNM_2(G) = \sum_{uv \in E(G)} d_{N'}(u) d_{N'}(v)$$

= 4n(2.3) + 7n(3.4) + 8n(2.4) + (5n+1)(1.2) + 10n(3.3) + (11n-1)(4.4) + 2n(2.2) + n(3.5) + n(5.5)+(6n-1)(4.5) + 1(2.5) + n(1.4)

= 620n-24

$RNM_1^*(G) = \sum_{uv \in E(G)} [d_{N'}(u) + d_{N'}(v)]$

= 4n(2 + 3) + 7n(3 + 4) + 8n(2 + 4) + (5n+1)(1 + 2) + 10n(3 + 3) + (11n-1)(4 + 4) + 2n(2 + 2)+n(3 + 5) + n(5 + 5) + (6n-1)(4 + 5) + 1(2 + 5) + n(1 + 4)

= 4n(5) + 7n(7) + 8n(6) +(5n+1) (3) + 10n(6) + (11n-1)(8) + 2n(4) + n(8) + n(10) + (6n-1)(9) + 1(7)+n(5)

= 365n-7

$HRN(G) = \sum_{uv \in E(G)} [d_{N'}(u) + d_{N'}(v)]^2$

= 4n(2 + 3)² + 7n(3 + 4)² + 8n(2 + 4)² + (5n+1)(1 + 2)² + 10n(3 + 3)² + (11n-1)(4 + 4)² + 2n(2 + 2)²+n(3 + 5)² + n(5 + 5)² + (6n-1)(4 + 5)² + 1(2 + 5)² + n(1 + 4)²

= 4n(5)² + 7n(7)² + 8n(6)² +(5n+1)(3)² + 10n(6)² + (11n-1)(8)² + 2n(4)² + n(8)² + n(10)² + (6n-1)(9)²+1(7)² +n(5)²

= 2547n-87

$RNM_3^*(G) = \sum_{uv \in E(G)} [d_{N'}(u)^2 + d_{N'}(v)^2]$

= 4n(2² + 3²) + 7n(3² + 4²) + 8n(2² + 4²) + (5n+1)(1² + 2²) + 10n(3² + 3²) + (11n-1)(4² + 4²)+2n(2² + 2²) + n(3² + 5²) + n(5² + 5²) + (6n-1)(4² + 5²) + 1(2² + 5²) + n(1² + 4²)

= 4n(13) + 7n(25) + 8n(20) + (5n+1)(5) + 10n(18) + (11n-1)(32) + 2n(8) + n(34) + n(50)+(6n-1)(41) + 1(29) + n(17)

= 1307n-39.

CONCLUSIONS

In this work, we have calculated some reduced neighborhood topological indices of Hyaluronic acid-curcumin conjugates such as reduced neighborhood version of first Zagreb Index, reduced neighborhood version of second Zagreb Index, reduced neighborhood version of the forgotten topological index and hyper reduced neighborhood index. In addition RNM-Polynomial associated with topological indices for hyaluronic acid-curcumin conjugates were also computed. The results obtained in this study can be incorporated in various QSAR models for its applications in the chemical and pharmaceutical science.

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Table 1: The reduced neighborhood vertex degree of G_n: $n = 1$.

$d_{N'}(v)$	1	2	3	4	5
No. of vertices with $d_{N'}(v)$	5	15	14	16	3

Table 2: The reduced neighborhood vertex degree of G_n.

$d_{N'}(u)$	1	2	3	4	5
$\|V_i(G_n)\|$	(4n+1)	(14n+1)	(13n+1)	(18n-2)	3n

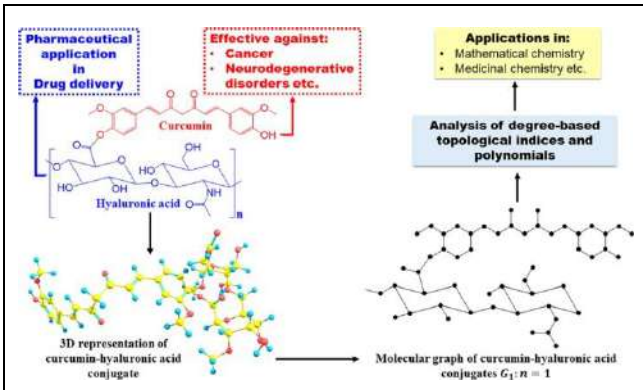

Figure 1. An illustration representing motivation of the current study

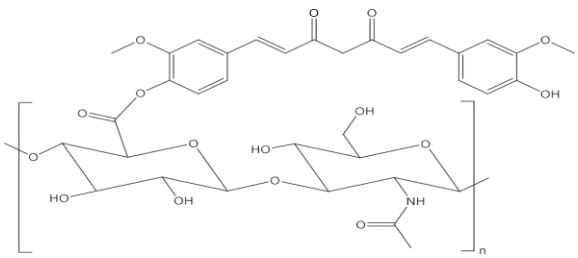

Figure 2. The molecular structure of hyaluronic acid- curcumin conjugates

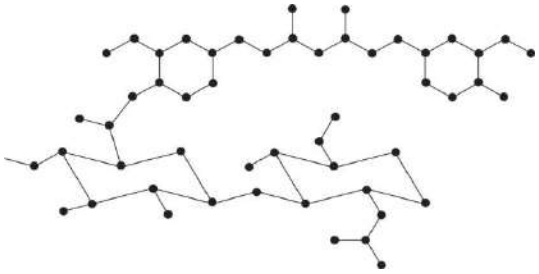

Figure 3. Corresponding molecular graph of HA-curcumin conjugates G_n: $n = 1$.

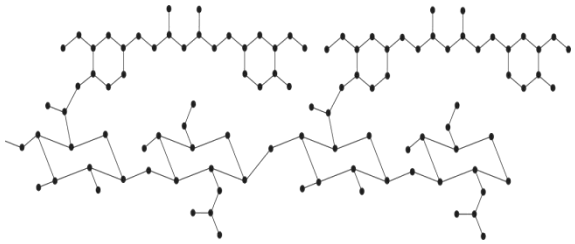

Figure 4. Corresponding molecular graph of HA-curcumin conjugates G_n: $n = 2$.

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RESEARCH ARTICLE

Avifaunal Diversity and Status Assessment in Kaimur Wildlife Sanctuary, Bihar, India

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ABSTRACT

The diversity and status of bird communities is crucial for understanding the conservation value at regional or local landscapes. Birds are natural sentinels, sensitive and significant environmental bioindicators. Bird research in every location allows us to gain a better grasp of the ecosystem's general health and to demonstrate the importance of any landscape or sanctuary for avifaunal conservation. The study was carried out at the six ranges of Kaimur wildlife sanctuary (KWLS), Bihar, India, from January to March 2021 to investigate the diversity and status of avifauna. The line transect method was used to cover the majority of the research region. There were 178 bird species recorded, divided into 19 orders and 61 families. The Bhabhua range has the maximum bird diversity, with 163 species, while the Adhaura has the least, with only 127 species. With 30 families and 79 species, Passeriformes was the most prominent order. This study also looked at the habitat occupancy and relative diversity index (RDi) of the local avifauna. According to habitat distribution, 69 percent of the species are terrestrially dependent, with aquatic (25 percent) and waders (6 percent) species respectively. The rdi of 5.6 was found highest in the families Anatidae and Accipitridae. As a result, KWLS offers a potential home for sound avifauna with a diverse population. To improve the status of resident and migratory birds, the area requires appropriate management and conservation initiatives as part of ecotourism.

Keywords: Kaimur wildlife sanctuary, avifauna, diversity, status

INTRODUCTION

Birds are a diversified, well-known, and easy-to-count species that serve as excellent markers of global biodiversity trends (Anderle et al.,[1] Kujawa[2], Callaghan et al.[3]). These are easily noticed and helpful indicator of biodiversity (Sultana et al.)[4]. Healthy bird variety might be a sign of green and sustainable development (Rajia et al.[5]; Redlich et al.)[6]. Seed dispersal (Bibi and Ali,)[7], pollination, pest control, nutrient cycling, and scavenging are all important ecological functions that birds play (Ramchandra)[8]. There are currently 11,162 different species of birds (class Aves) living on the planet, divided into 27 Orders and 155 families (BLI,)[9]. According to IUCN, there are 1,445 species are globally threatened species, 776 species are vulnerable on the near threatened, 447 are endangered species and 225 species are critically endangered category. India has 1210 bird species, including 76 endemics, 94 globally threatened, 17 critically endangered, 20 endangered, 57 vulnerable, and 78 near threatened respectively. There are 460 different migratory bird species in the country. Birds are very vulnerable to environmental changes, such as climate and LULC shifts (Scridel et al.[10]; Siriwardena et al.) [11]. The composition of bird species is strongly linked to forest vegetation structure (Torrenta and Villard,[12]; Robertson and Hackwell,)[13]. Large differences in forest bird reactions to varying levels of forest management intensity have been reported in forest landscapes (Uezu and Metzer, [14]; Schulze et al.)[15]. In the current forest landscapes site conditions, have been affected by human activities mainly linked to silvicultural practices, creating a complex mosaic of forest patches of different sizes, successional stages, tree species composition and vertical complexity (Bengtsson et al.)[16]. In this context, forest cover and fragmentation result in large differences in environmental conditions available to forest birds across landscapes (Tellería et al.)[17]. Moreover, the situation is dynamic due to the ongoing interplay between land-use change and climate change (Barbet-Massin et al.[18], Lemoine et al.[19]. Bihar is a state in eastern India lying in the Gangetic plain with a forest cover of about 7,305.99 sq. km. The state has twelve wildlife sanctuary and one national park. In the state, numerous ornithological research on diversification and conservation status have been undertaken (Mishra et al.[20], Kumari et al.[21]; Sharma and Mishra, [22]. But in protected areas avian diversity is lacking. Only some studies has been conducted in: Vikramshila Gangetic Dolphin Sanctuary (Dey,)[23],Valmiki Tiger Reserve (Choudhary)[24], Bhimbandh Wildlife Sanctuary (Khan and Pant)[25], Gautam Buddha Wildlife Sanctuary (Sharma and Kumar)[26] and Kaimur wildlife sanctuary (ZSI)[27].

The Kaimur wildlife sanctuary is located in the Rohtas and Bhabua districts of Bihar. The total area of the sanctuary comprises 1342.22 sq. km. KWLS has two provinces; Central highlands in the west, which comprise, Satpura-Maikal hills and Vindhya-Bagelkhand hills. In the east and south, there is the Chota Nagpur Plateau. The sanctuary has two parts, viz. plains and plateau regions. The foot hills of Kaimur area consists of the alluvial soil and is naturally fertile. Panoramic grassland, tropical dry deciduous forest, and swampy marshes make up the landscape. Because of the variety of habitats, temperature regimes, and height range, the region provides favorable habitats for avifauna. A different type of vegetation can be seen on the Kaimur hill. In parts, the unique white-barked *Sterculia foelida* spreads over the sheer cliffs, and enormous tracts of bamboo cover the debris at its base. *Cassia fistula*, *Bombax ceiba*, *Terminalia chebula*, and *Diospyrous melanoxylon* are among the significant trees encountered. As the plain approaches the foot hills, the soil becomes stony and is poor in fertility. (Bhattacharya and Ghosh)[28]. The Kaimur plateau is an undulating table land having thin scrubby jungles and the land is not at all fertile. There are also some patches bereft of any vegetation at the top hill part. Soil erosion in these forests is very common. Sugar cane, poppy, rice, and a variety of other food crops are grown in the cultivated area. This area is either barren or populated with bamboo clumps and mango orchards. Palmyra (*Borassus flabelliformis*) and Date-Palm groves typically surround the settlements within the sanctuary (*Phoenix sylvestris*). Pipal (*Ficus religiosa*) and Banyan (*Ficus indica*) are prevalent in the alluvial area that stretches to the foot of the hills. The Bel (*Aegle marmelos*), Neem (*Azadirachta indica*), Siris (*Albizia spp.*), and Jack Fruit (*Albizia spp*.) are the other main trees in this area (*Artocarpus heterophyllus*). According to Champion and Seth (1968)[29] the entire area of the sanctuary has a good natural Sal forests associated with Northern tropical mixed dry deciduous forests, *Boswellia* forests and dry bamboo drakes. During rainy and winter months, the sanctuary's water supply is sufficient. There are six rivers *viz*; Karamnasa, Durgawati, Tilhar, Suvra, Kudra, and Varuna that give water throughout the year. Summer (mid-March to mid-May), Monsoon (mid-May to

mid-October), and winter (mid-October to mid-March) are the three distinct seasons that are identified. During the monsoon season, the sanctuary's forested areas receive higher rainfall, ranging from 24 to 35 cm. Being associated with other ecological zones, the sanctuary has given rise to a rich and diversified fauna. The goal of this study is to assess the diversity and status of bird species found in various landscapes of the Kaimur wildlife sanctuary that have been little or undiscovered previously.

MATERIALS AND METHODS

The avifaunal survey was conducted in six ranges *viz*: Mundeshwari, Makrikhoh, Adhaura, Karkatgarh, Bhabua, and Mohaniya of KWLS from 28 January to 30 March 2021 (Fig-1). The areas which has been selected for the study were mainly dense forest, open grassland, ponds, hill tops, and dams. The surveys were conducted at regular intervals between 7:00 to 10:00 a.m. and 15:30 to 18:30 p.m. (when birds were most active throughout the day). Birds were observed in all six ranges according to their habitat like aquatic, terrestrial, and waders. In the pre-defined locations, line transacts (Bibby[30]; Sutherland et al.[31]; Kumar et al.[32],Khan et al.)[25] and the point count method ((Bibby et al.[31]; Hutto [33]; Sutherland)[31] were used. Some species, such as raptors and nocturnal birds, were discovered on the spur of the moment. Birds were identified through different field guides (Ali [33]; Ali and Ripley [35]; Neelakantan [36]; Grimmet et al.[37]; Grewal et al.)[38], using field binoculars Nikon (10*50) and photographs taken by using Nikon D3400 and Nikon D5300 cameras with appropriate zoom lenses. The International Union for the Conservation of Nature (IUCN) status was also used to compare the local status with the global status. The relative diversity (RDi) of the families were calculated using the formula: RDi = Number of Bird Species in a Family*/ Total No. of Species (Torre-Cuadros et al.)[39]. The percentage representation of the family and species in order were calculated by using the formula: % Representation of Family in order = No. of Family in Particular order*/ Total No. of order X 100 (Lakshmi et al.)[40]. % Representation of Species in order = No. of Species in Particular order*/ Total No. of order X 100 (Lakshmi et al.)[40]

RESULTS AND DISCUSSION

In the six ranges of the study area, a total of 178 bird species from 19 orders and 61 families were recorded (Table-1). In the previous study of the KWLS Bhattacharya and Ghosh [28] has recorded 127 bird species. The topographical condition of the KWLS is determined to be ideal for bird habitat, as it provides ideal breeding, feeding, roosting, and nesting sites that range from open to dense forest, including wetlands. Similarly Sharma et al. [41] also stated that the distribution of birds in a particular area depends on various factors, which include quantity and quality of food available, perching, roosting and nesting sites. The 178 bird species recorded in the KWLS has been distributed in six ranges in which 163 (92 %) were found in the Bhabhua Range, followed by Mohaniya 162 (91 %), Karkatgarh 160 (89 %), Makrikhoh 137 (77 %), Mundeshwari 135 (76 %), and Adhaura 127 (71%) mentioned in Table-2. Bhabhua range has the most diversity of birds (91.51 percent), because it includes forest, wetlands, and agricultural landscapes, as well as human habitation, and most common birds prefer the fringe of the forest or near human habitation. The Karkatgarh range, on the other hand, includes 160 species, not much less than Bhabhua, and a deep forest with little or no habitation. The presence of the Karamnasa river, which provides a suitable habitat for water birds, could be one of the reasons for the high diversity. The addition of water birds to the total population helped to diversify the bird population in the area. Because of the deep forest and lack of water sources, the Adhaura and Makrikhoh ranges have less diversity, limiting the spread of many bird species. Despite the fact that the Mundeshwari range's forest structure is comparable to that of the Bhabhua range, the diversity of birds is lower, owing to the existence of religious pilgrimage and an overcrowded population. Fig-2 & 3 demonstrate the number and percentage composition of families and species in various orders. Passeriformes dominates the 19 bird orders, accounting for 79 (44.38%) of the total species, followed by Charadriiformes 14 (7.86 %), Accipitriformes 11 (6.17%), Pelecaniformes and Anseriformes each with 10 (5.6%), Coraciformes 7 (3.93%), Columbiformes and Cuculiformes each with 6 (3.3%), Galliformes, Caprimulgiformes, Strigiformes, and Pisciformes each with 05 (2.8%), Gruiformes 4 (2.24%), Suliformes and pssitaciformes each with 3 (1.08%), Bucerotiformes 2 (1.12%) and Podicipediformes, Ciconiiformes,

Falconiformes each with 1 species (0.58%). Passeriformes has been reported to be the most diverse order from Forest and other agricultural landscapes (Mukhopadhyay and Mazumdar, [42]; Narayana et al.)[43]. Total 61 families were recorded in which the order Passeriformes has maximum thirty families (49%), followed by Charadriiformes with six (9.83%), Coraciiformes with three (4.9%), Pelecaniformes, Accipitriformes, Caprimugliformes, Strigiformes, Bucerotiformes, and Pisciformes with two (3.27%), and Podicidiformes, Suliformes, Ciconiformes, Anseriformes, Falconiformes, Galliformes, Gruiformes, Columbiformes, Cuculiformes, and Psittaciformes each with one family (about 1.63%). Order Passeriformes has also been reported having the maximum number of family in Nawabganj bird sanctuary, Unnao, Uttar Pradesh. (Kumar et al.)[44] and Kolleru lake, Andhra Pradesh (Lakshmi et al.)[40]. Based on the information of habitat use on our own observations, we identified three principal habitat-use guilds. 123 (about 69%) of the species were dependent on terrestrial environment, followed by Aquatic habitat type 44 (25%), and Waders 11 (6 %). Birds are known to choose habitats that provide unique foraging and breeding opportunities. It was also discovered that a nearby dry land area characterised by patches of shrubs and fruiting trees had attracted a number of bird species, primarily highland birds. Knight et al., [45] also stated that adjacent dry land area dominated by patches of shrubs and fruiting trees had also attracted a number of bird species particularly upland birds i.e., may be only facultative marsh inhabitants. KWLS is rich in marsh and lake areas, but only 25% of birds are dependent on aquatic habitat type, and only 6% are water dependent. The reason is that most aquatic or water dependent birds are migratory and visit the sanctuary only during a specific season, and their occurrence is also influenced by the depth of water, food resources, and foraging behaviour. Michel et al.[46]; Crampton et al.[47]; Carrascal et al.[48] also observed that avian community structures in the marsh and lake areas were influenced by a number of variables such as water depth, vegetation structure and composition, food resources and foraging behaviour

The Anatidae and Accipitridae families had the highest RDi (5.6), whereas the Podicipedidae, Ciconiidae, Pandionidae, Falconidae, Burhinidae, Recurvirostridae, Laridae, Tytonidae, Coraciidae, Upupidae, Bucerotidae, Siltidae, Certhiidae, Paridae, Vangidae, Chloropscidae, Turdidae, Aegithinidae, Sylviidae, Timalidae, Zoosteropidae and Plocidae has the lowest RDi (0.56). (Fig-4). On the contrary many other researchers such as Sankar et al. [49], Sharma et al.[41], Chhangani [50], and Yaseen et al. [51] have also found Muscicapidae to be the largest family in the different protected areas of India. The families Anatidae and Accipitridae has the highest ten species, followed by eight species of Ardeidae and Muscicapidae, and six species of Scolopacidae, Columbidae, Cuculide, and Sturnidae respectively. Similarly, Anatidae and Accipitridae has been found to be most diverse in family in other parts of India (Kumari et al.[21]; Ramesh et al.[52]. However, Muscicapidae and Ardeidae has been reported to be the most diverse family in many protected areas (Chhangani,[50]; Samson et al.[53]; Sankar et al.[49]; Yaseen et al.)[51] and also in human-dominated landscapes (Kasambe and Khan.)[54]. In addition, 22 families were underrepresented in the study with only one species: Ploceidae, Zosteropidae, Timalidae, Sylvidae, Agithinidae, Turdidae, Chloropseidae, Vangidae, Paridae, Certhidae, Siltidae, Bucerotidae, Upupidae, Coraciidae, Tytonidae, Laride, Recurvirostridae, Burhinidae, Falconidae, Pandionadae, Ciconiidae and Podicipedidae. Similar observation has been made in Todgarh-Raoli Wildlife Sanctuary, Rajasthan, India (Koli) [55]. According to the IUCN red list [56], two bird species, the Common Pochard and River Tern, are Vulnerable, while the Himalayan Griffon and Alexandrine Parakeet are Near Threatened, and the Egyptian Vulture is endangered. The research area has a diverse range of habitats, which allows for a wide variety of dietary habits. Birds have been classified as Piscivorous, Insectivorous, Carnivorous, Omnivorous, Granivorous, Vegetarian, and Frugivorous based on their eating habits and dietary preferences. A close relation between aquatic food plants and their consumer birds have been explained by Jha [57]. A significant number of insectivorous species, present in the study area, are important agents of biocontrol of insect pest in agriculture, horticulture, and forests (Mahabal [58]; Thakur et al.)[59].

CONCLUSION

We can ensure that future generations can appreciate our natural world and the amazing animals that live within it by conserving wildlife. The preservation of global species diversity has emerged as one of the most important issues

today (Hu et al.)[60]. Protected areas, such as wildlife sanctuaries, national parks, and biodiversity reserves, are increasingly recognized as critical to supporting biodiversity and play a key role in essential ecological functions, such as ecosystem services, climatic stabilization, carbon sequestration, groundwater recharge, nutrient retention, and natural disaster prevention (DeFries et al.)[61]. It's crucial to understand how species interact within their ecosystems and how they're affected by environmental and human factors in order to assist safeguard animals. Birds fly from one location to another, therefore they encounter various problems. We must safeguard not just their winter and summer habitat, but also important rest spots used by migratory birds along the journey. Protecting habitat along important migratory flyways/pathways utilized by migratory birds can benefit endangered bird populations. Birds follow well-worn paths from their winter eating areas to their summer breeding grounds and back. Flyways are most commonly found near beaches, major rivers, and mountains. The Kaimur wildlife sanctuary offers a diverse range of habitats suited for a wide range of bird species, and this study provides a framework for the conservation of critical habitats inside the sanctuary, not just for birds but also for other species.

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Table- 1: list of the birds found in kwls with their order, habitat, feeding habitat, population status, iucn status and residential status.

Sr. No.	Common name	order/family/ scientific name	Habitat	Feeding habit	Population status	IUCN status	Residential status
		Order :Podicipediformes					
		Family: Podicipedidae					
1	Little grebe	*Tachybaptus ruficollis*	AH	Pis/Inc	C	LC	R
		Order: Suliformes					
		Family :Phalacrocoracidae					
2	Little Cormorant	*Microcarbo niger*	AH	Pis/Car	C	LC	R
3	Indian cormorant	*Phalacrocorax fuscicollis*	AH	Pis	MC	LC	WV
4	Greater cormorant	*Phalacrocorax carbo*	AH	Pis	VC	LC	WV
		Order:Pelecaniformes					
		Family: Ardeidae					
5	Indian Pond Heron	*Ardeola grayii*	AH	Car	MC	LC	R
6	Black crowned night heron	*Nycticorax nycticorax*	AH	Pis/Car/Om	R	LC	R
7	Purple Heron	*Ardea purpurea*	AH	Pis/Car/Om	R	LC	R
8	Cattle egret	*Bubulcus ibis*	AH	Inc/Car	VC	LC	R
9	Little Egret	*Egretta garzetta*	AH	Pis/Inc/Car	C	LC	R
10	Intermediate egret	*Ardea intermedia*	AH	Pis/Car/Inc	C	LC	R
11	Great Egret	*Ardea alba*	AH	Pis/Car	C	LC	R
12	Cinnamon Bittern	*Ixobrychus cinnamomeus*	AH	Pis/Car/Inc	C	LC	R
		Family: Threskiornithidae					
13	Red-naped Ibis	*Pseudibis papillosa*	AH	Car/Inc	VC	LC	WV
14	Oriental White Ibis	*Threskiornis melanocephalus*	AH	Car/Pis	C	LC	WV
		Order: Ciconiiformes					
		Family: Ciconiidae					
15	Asian open bill	*Anastomus oscitans*	AH	Pis/Car	VC	LC	R
		Order : Anseriformes					
		Family : Anatidae					
16	Lesser Whistling- duck	*Dendrocygna javanica*	AH	Veg/Pis/Car	MC	LC	WV
17	Cotton Pygmy-goose	*Nettapus coromandelianus*	AH	Veg/Inc	VC	LC	R
18	Common pochard	*Aythya ferina*	AH	Veg/Inc	C	VU	WV
19	Red Crested pochard	*Rhodonessa rufina*	AH	Veg/Aq.Inc	MC	LC	WV
20	Garganey	*Anas querquedula*	AH	Veg/Aq.Inc	VC	LC	WV
21	Gadwall	*Anas strepera*	AH	Aq.Veg/Inc	VC	LC	WV
22	Northern Pintail	*Anas acuta*	AH	Veg/Inc	VC	LC	WV
23	Knob billed duck	*Sarkidiornis melanotos*	AH	Veg/Aq.Inc	C	LC	WV
24	Northern Shoveler	*Spatula clypeata*	AH	Inc/Veg	C	LC	WV
25	Mallard	*Anas platyrhynchos*	AH	Veg	MC	LC	WV
		Order: Accipitriformes					
		Family: Pandionidae					
26	Osprey	*Pandion haliaetus*	T	Pis/Car/P	R	LC	WV
		Family: Accipitridae					
27	Shikra	*Accipiter badius*	T	Car/P	C	LC	R
28	Black Kite	*Milvus migrans*	T	Om/P	VC	LC	R
29	Black shouldered kite	*Elanus caeruleus*	T	Car/Inc/P	C	LC	R

30	White eye buzzard	*Butastur teesa*	T	Car/P	C	LC	R
31	Oriental Honey Buzzard	*Pernis ptilorhynchus*	T	Car/P	C	LC	R
32	Short toed Snake Eagle	*Circaetus gallicus*	T	Car/P	C	LC	PM
33	Crested Serpent eagle	*Spilornis ceela*	T	Car/P	C	LC	R
34	Booted Eagle	*Hieraaetus pennatus*	T	Car/P	C	LC	PM
35	Egyptian Vulture	*Neophron percnopterus*	T	Car	VC	EN	R
36	Himalyan Griffon vulture	*Gyps himalyensis*	T	Car	C	NT	WV
		Order: Falconiformes					
		Family: Falconidae					
37	Common Kestral	*Falco tinnunculus*	T	Car/Inc/P	VC	LC	WV
		Order : Galliformes					
		Family: Phasianidae					
38	Grey Francolin	*Francolinus pondicerianus*	T	Inc/Om/Gra	VC	LC	R
39	Jungle Bushquail	*Perdicula asiatica*	T	Inc/Gra/Om	C	LC	R
40	Black Francolin	*Francolinus francolinus*	T	Inc/Om/Gra	R	LC	R
41	Red Junglefowl	*Gallus gallus*	T	Inc/Om/Gra	C	LC	R
42	Indian Peafowl	*Pavo cristatus*	T	Inc/Om/Gra/Car	MC	LC	R
		Order: Gruiformes					
		Family: Rallidae					
43	Eurasian Coot	*Fulica atra*	AH	Veg/Om	VC	LC	WV
44	Common Moorhen	*Gallinula chloropus*	AH	Om	VC	LC	WV
45	Grey Headed Swamphen	*Porphyrio porphyria*	AH	Veg/Inc	C	LC	R
46	White Breasted Waterhen	*Amaurornis phoenicurus*	AH	Om	C	LC	R
		Order: Charadriiformes					
		Family: Jacanidae					
47	Bronzed Winged Jacana	*Metopidius indicu*	AH	Veg/Inc	C	LC	R
48	Phesant tailed Jacana	*Hydrophasianus chirurgus*	AH	Veg/Inc	C	LC	R
		Family: Burhinidae					
49	Indian Thic-knee	*Burhinus oedicnemus*	W	Veg/Inc	C	LC	R
		Family: Charadriidae					
50	Red wattled Lapwing	*Vanellus indicus*	W	Veg/Inc	MC	LC	R
51	Yellow wattled Lapwing	*Vanellus cinereus*	W	Veg/Inc	C	LC	WV
52	Little ringed Plover	*Charadrius placidus*	W	Car/Inc	VC	LC	R
		Family: Recurvirostridae					
53	Black winged Stilt	*Himantopus himantopus*	W	Car/Inc	VC	LC	WV
		Family: Scolopacidae					
54	Common Greenshank	*Tringa nebularia*	W	Inc	MC	LC	WV
55	Marsh Sandpiper	*Tringa stagnatilis*	W	Aq.Inc/Pis	C	LC	WV
56	Green Sandpiper	*Tringa ochropus*	W	Pis/Inc	C	LC	WV
57	Common Sandpiper	*Actitis hypoleucos*	W	Aq.Inc	MC	LC	WV
58	Wood Sandpiper	*Tringa glareola*	W	Inc/Pis	C	LC	WV
59	Temminck's Stint	*Calidris temminckii*	W	Inc/Veg	VC	LC	WV

		Family: Laridae					
60	River Tern	*Sterna aurantia*	AH	Pis/Aq.Inc	C	VU	R
		Order: Columbiformes					
		Family: Columbidae					
61	Rock pigeon	*Columba libia*	T	Gra/Veg	C	LC	R
62	Laughing Dove	*Spilopelia seegalensis*	T	Gra/Veg	MC	LC	R
63	Spotted Dove	*Spilopelia chinensis*	T	Gra/Veg	VC	LC	R
64	Oriental Turtle dove	*Streptopelia orientalis*	T	Gra	C	LC	R
65	Red collared dove	*Streptopelia tranquebarica*	T	Gra	R	LC	R
66	Eurasian Collared Dove	*Streptopelia decaocto*	T	Gra/Veg	VC	LC	R
		Order: Cuculiformes					
		Family: Cuculidae					
67	Greater coucal	*Centropus sinensis*	T	Inc/Car/Fru	VC	LC	R
68	Common hawk cuckoo	*Hierococcyx various*	T	Inc/Fru/Car	C	LC	PM
69	Small green billed Malkoha	*Phaenicophaeus viridirostris*	T	Fru/Inc	R	LC	PM
70	Sirkeer Malkoha	*Taccocua leschenaultii*	T	Fru/Inc	R	LC	PM
71	Asian koel	*Eudynamys scolopaceus*	T	Fru/Inc/Nec	VC	LC	R
72	Indian Cuckoo	*Cuculus Micropterus*	T	Inc	C	LC	PM
		Order: Pissaticiformes					
		Family: Psittaculidae					
73	Rose ringed parakeet	*Psittacula krameria*	T	Fru	MC	LC	
74	Alexandrine parakeet	*Psittacula eupatria*	T	Fru	VC	NT	
75	Plum headed parakeet	*Psiittacula cyanocephala*	T	Fru	VC	LC	
		Order: Caprimugliformes					
		Family: Caprimuglidae					
76	Indian nightjars	*Caprimulgus asiaticus*	T	Inc	VC	LC	R
77	Savanna Nightjar	*Caprimulgus affinis*	T	Inc	C	LC	R
		Family: Apodidae					
78	House swift	*Apus nipalensis*	T	Inc	MC	LC	R
79	White-rumped Spinetail	*Zoonavena sylvatica*	AH	Inc	MC	LC	R
80	Little swift	*Apus affinis*	AH	Inc	VC	LC	R
		Order: Strigiformes					
		Family: Strigidae					
81	Spotted owlet	*Athene brama*	T	Car/Inc/P	VC	LC	R
82	Jungle owlet	*Glaucidium radiatum*	T	Car/Inc/P	C	LC	R
83	Indian scoops owl	*Otus bakkamoena*	T	Car/P	R	LC	R
84	Brown Fish Owl	*Ketupa zeylonensis*	T	Pis/P	R	LC	R
		Family: Tytonidae					
85	Barn owl	*Tyto alba*	T	Car/P	VC	LC	R
		Order: Coraciiformes					
		Family: Alcedinidae					
86	Common Kingfisher	*Alcedo atthis*	AH	Pis/Inc	VC	LC	R
87	White throated kingfisher	*Halcyon smyrnensis*	AH	Car/Pis/Inc	MC	LC	R
88	Pied Kingfisher	*Ceryle rudis*	AH	Pis/Inc	C	LC	R
89	Stork Billed Kingfisher	*Pelargopsis capensis*	AH	Pis/Inc/Car	R	LC	R

		Family: Meropidae					
90	Green bee eater	*Merops orientalis*	T	Inc	MC	LC	R
91	Blue tailed Bee Eater	*Merops philippinus*	T	Inc	C	LC	R
		Family: Coraciidae					
92	Indian roller	*Coracias benghalensis*	T	Inc/Car	VC	LC	R
		Order: Bucerotiformes					
		Family: Upupidae					
93	Eurasian Hoopoe	*Upupa epops*	T	Inc	C	LC	R
		Family: Bucerotidae					
94	Indian grey hornbill	*Ocyceros birostris*	T	Fru/Inc	VC	LC	R
		Order: Piciformes					
		Family: Megalimidae					
95	Copper smith barbet	*Psilopogon haemacephalus*	T	Fru/Inc	VC	LC	R
96	Brown headed barbet	*Psilopogon zeylanicus*	T	Fru/Inc	C	LC	R
		Family: Picidae					
97	Brown caped pygmy woodpecker	*Dendrocopos nanus*	T	Inc/Fru/Nec	C	LC	R
98	Yellow crowned woodpecker	*Leiopicus mahrattensis*	T	Inc/Fru/Nec	C	LC	R
99	Eurasian wryneck	*Jynx torquilla*	T	Inc	R	LC	PM
		Order: Passeriformes					
		Family: Sittidae					
100	Chestnut bellied nuthatch	*Sitta cinnamoventris*	T	Inc/Fru	R	LC	R
		Family: Certhiidae					
101	Spotted treecreeper	*Salpornis spilonota*	T	Inc	R	LC	R
		Family: Paridae					
102	Great Tit	*Parus major*	T	Fru/Inc	VC	LC	WV
		Family: Hirundinidae					
103	Barn swallow	*Hirundo rustica*	AH	Inc	VC	LC	WV
104	Wired tailed swallow	*Hirundo smithii*	AH	Inc	MC	LC	R
105	Dusky Craig Martin	*Ptyonoprogne concolor*	AH	Inc	VC	LC	R
		Family:Dicruridae					
106	Black drongo	*Dicrurus macrocercus*	T	Inc/Car/Nec	MC	LC	R
107	White bellied drongo	*Dicrurus caerulescens*	T	Inc/Nec	C	LC	R
108	Greater Racket tailed drongo	*Dicrurus paradiseus*	T	Inc/Nec	C	LC	SV
109	Spangled Drongo	*Dicrurus hottentatus*	T	Inc/Car/Nec	R	LC	SV
		Family: Campephagidae					
110	Black headed cuckoo shrike	*Lalage melanoptera*	T	Inc/Fru	C	LC	R
111	Small minivet	*Pericrocotus cinnamomeus*	T	Inc	VC	LC	WV
		Family: Vangidae					
112	Common wood shrike	*Tephrodornis pondicerianus*	T	Inc	C	LC	R
		Family: Laniidae					
113	Bay backed shrike	*Lanius vittatus*	T	Inc/Car	C	LC	R
114	Long tailed shrike	*Lanius schach*	T	Inc/Car	C	LC	R
115	Brown shrike	*Lanius cristatus*	T	Inc	C	LC	R

		Family: Oriolidae					
116	Eurasian golden oriole	*Oriolus oriolus*	T	Fru/Veg/Inc/Car	VC	LC	R
117	Black hooded oriole	*Oriolus xanthornus*	T	Veg/Inc	C	LC	R
		Family: Chloropseidae					
118	Golden Fronted Leaf bird	*Chloropsis aurifrons*	T	Inc/Nec/Fru	R	LC	R
		Family: Sturnidae					
119	Chestnut-tailed Starling	*Sturnus malabaricus*	T	Fru/Inc	C	LC	SV
120	Asian Pied Starling	*Gracupica contra*	T	Inc/Fru/Gra	VC	LC	R
121	Common Myna	*Acridotheres tristis*	T	Inc/Fru/Veg/Nec/Car	MC	LC	R
122	Bank myna	*Acridotheres ginginianus*	T	Fru/Inc/Gra	VC	LC	R
123	Brahminy starling	*Sturnia pagodareum*	T	Fru/Inc	C	LC	R
124	Jungle Myna	*Acridotheres fuscus*	T	Fru/Gra/Nec/Inc	C	LC	R
		Family: Pycnonotidae					
125	Red vented bulbul	*Pycnomotus cafer*	T	Fru/Nec/Inc	VC	LC	R
126	Red whishkered bulbul	*Pycnomotus jocosus*	T	Fru/Nec/Inc	C	LC	R
127	White browed bulbul	*Pycnonotus luteolus*	T	Fru/Inc	R	LC	SV
128	Black crested Bulbul	*Pycnonotus flaviventris*	T	Fru/Inc/Nec	R	LC	R
		Family: Muscicapidae					
129	Oriental magpie robin	*Copsychus saularis*	T	Inc	MC	LC	R
130	Indian robin	*Copsychus fulicatus*	T	Inc	VC	LC	R
131	White rumped shama	*Copsychus malabaricus*	T	Inc/Fru	C	LC	SV
132	Black redstart	*Phoenicurus ochruros*	T	Inc	VC	LC	R
133	Rusty tailed flycatcher	*Ficedula ruficauda*	T	Inc	C	LC	SV
134	Verditer flycatcher	*Eunyias thalassinus*	T	Inc	C	LC	SV
135	Brown Rock Chat	*Cercomela fusca*	T	Inc/Gra	VC	LC	R
136	Pied Bush Chat	*Saxicola caprata*	T	Inc/Veg	C	LC	SV
		Family: Turdidae					
137	Orange headed Thrush	*Geokichla citrina*	T	Inc	R	LC	SV
		Family: Rhipiduridae					
138	White Browed Fantail	*Rhipidura aureola*	T	Inc/Car	C	LC	R
139	White Throated Fantail	*Rhipidura albicollis*	T	Inc/Car	C	LC	R
		Family: Aegithinidae					
140	Common iora	*Aegithina tiphia*	T	Inc	C	LC	R
		Family: Motacillidae					
141	Citrine wagtail	*Motacilla citreola*	AH	Inc	C	LC	WV
142	White wagtail	*Motacilla alba*	AH	Inc	C	LC	WV
143	Grey wagtail	*Motacilla cinerea*	AH	Inc	C	LC	WV
144	Paddy field pipit	*Anthus rufulus*	T	Inc/Veg	VC	LC	R
145	Tree Pipit	*Anthus trivialis*	T	Inc	VC	LC	R
		Family: Sylviidae					
146	Yellow eyed babbler	*Chrysomma sinense*	T	Inc	C	LC	R
		Family: Timaliidae					
147	Tawny bellied babbler	*Dumetia hyperythra*	T	Inc	C	LC	R

		Family: Leiothrichidae					
148	Jungle babbler	*Argya striata*	T	Inc/Fru	MC	LC	R
149	Large grey babbler	*Argya malcolmi*	T	Inc	C	LC	WV
150	Common Babbler	*Argya caudata*	T	Inc/Om	C	LC	R
		Family: Cistcolidae					
151	Plain prinia	*Prinia inornate*	T	Inc/Nec	VC	LC	R
152	Ashy prinia	*Prinia socialis*	T	Inc/Nec	MC	LC	R
153	Rufous Fronted prina	*Prinia buchanani*	T	Inc/Nec	C	LC	R
154	Common tailor bird	*Orthotomus sutorius*	T	Inc/Nec	VC	LC	R
155	Zitting Cisticola	Cisticola juncidus	T	Inc	C	LC	WV
		Family: Corvidae					
156	House Crow	*Corvus splendens*	T	Om/Fru/Car	C	LC	R
157	Large Billed Crow	*Corvus macrorhynchos*	T	Om	VC	LC	R
158	Rufous tree Pie	*Dendrocitta vagabunda*	T	Fru/Car/Inc	VC	LC	R
		Family: Dicaeidae					
159	Pale billed lowerpecker	*Dicaeum erythrorhynchos*	T	Nec/Fru	C	LC	R
160	Thick Billed Flowerpeckar	*Dicaeum agile*	T	Nec/Fru	VC	LC	R
		Family: Zosteropidae					
161	Oriental White Eye	*Zosterops palpebrosus*	T	Fru/Nec/Inc	VC	LC	R
		Family: Nectariniidae					
162	Purple sunbird	*Cinnyris asiaticus*	T	Nec	VC	LC	R
163	Purple rumped sunbird	*Leptucoma zeylonica*	T	Nec	VC	LC	R
		Family: Alaudidae					
164	Rufous tailed lark	*Ammomanes phoenicura*	T	Gra/Inc	C	LC	R
165	Ashy crowned sparrow lark	*Eremopterix griseus*	T	Inc	C	LC	PV
166	Singing Bush lark	*Mirafra cantillans*	T	Veg/Inc	C	LC	R
167	Red Winged bush lark	*Mirafra hypermetra*	T	veg/Inc	R	LC	R
168	Oriental Sky lark	*Alauda gulgula*	T	Inc/Veg	C	LC	R
		Family: Phylloscopidae					
169	Common chiffchaff	*Phylloscopus collybita*	T	Gra/Inc	VC	LC	R
170	Greenish warbler	*Phylloscopus trochiloides*	T	Inc	VC	LC	R
171	Sulphur bellied warbler	*Phylloscopus griseolus*	T	Inc	VC	LC	WV
		Family: Estrildidae					
172	Scaly breasted munia	*Lonchura punctulata*	T	Gra	MC	LC	R
173	Tri-coloured munia	*Lonchura Malacca*	T	Gra	C	LC	R
174	Indian Silverbill	*Euodice malabarica*	T	Gra	MC	LC	R
175	Red Avadavat	*Amandava amandava*	T	Gra	C	LC	R
		Family: Ploceidae					
176	Baya weaver	*Ploceus philippinus*	T	Gra/Inc	VC	LC	R
		Family: Passerinae					
177	Yellow throated sparrow	*Gymnoris xanthocollis*	T	Om/Inc/Veg	VC	LC	R
178	House sparrow	*Passer domesticus*	T	Om/Inc/Veg	C	LC	R

Table 2. Birds Species Diversity In The Different Ranges of the Kaimur Wildlife Sanctuary

FOREST RANGE	NO. OF SPECIES	PERCENTAGE
Mundeshwari	135	75.84
Makrikhoh	137	76.96
Adhaura	127	71.34
Karkatgarh	160	89.88
Bhabua	163	91.51
Mohaniya	162	91.01

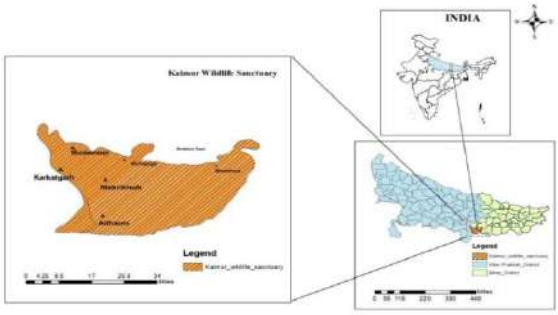

Fig. 1. Location Map of Kaimur Wildlife Sanctuary

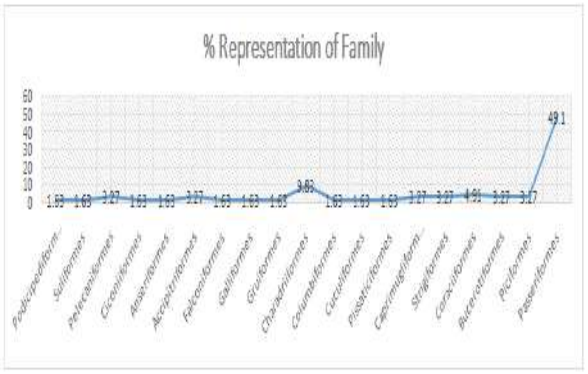

Fig. 2. Representation Of Families In Different Order

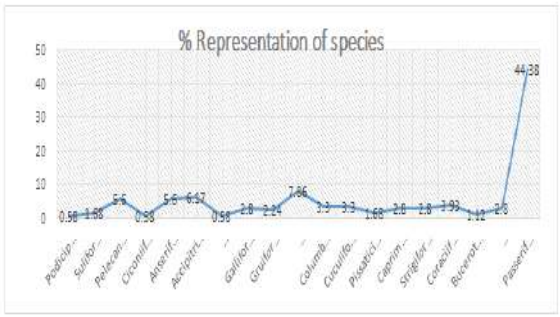

Fig. 3. Representation of Species in Different Order

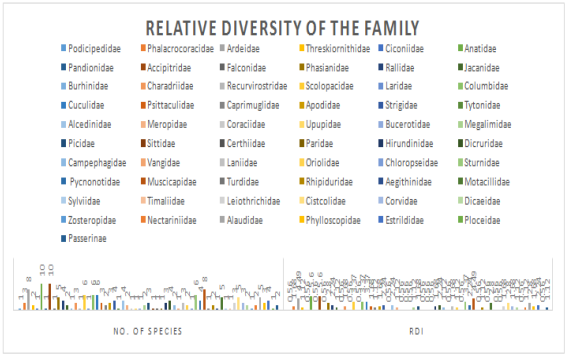

Fig. 4. Graphical Representation of Relative Diversity of the Families in Kaimur Wildlife Sanctuary

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RESEARCH ARTICLE

Biochemical Characterization of Chitinolytic Bacterial Isolates and its Consortium Based Formulation as an Effective Biocontrol Agent against Dry Root Rot Disease in Groundnut

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ABSTRACT

The king of oil seeds, groundnut is one of the most important oilseed and cash crops of our country. The yield loss in groundnut was due to several biotic factors *viz*., weeds, pest, bacteria, virus and fungal disease. The use of microorganism to control plant pathogen, known as biological control, is now in practice and has increasingly captured the attention of scientists as an alternative strategy for disease management. The use of many common pesticides causes serious health problems. Thus, it is important to explore new alternatives for disease control that reduce economic loss and have no negative effects on human health. Chitinolytic microorganisms have been used as biocontrol agents for several crops with promising results. Hence, the present investigation was conducted to test the different chitinolytic microbes as a potential biocontrol agent against fungal disease dry root rot of groundnut. Chitinolytic bacteria (*Bacillus subtilis, Bacillus licheniformis* and *Pseudomonas fluorescens*) were isolated from the groundnut rhizosphere soil sample and efficient isolates were developed as consortium. The effect of seed treatment with the chitinolytic bacterial consortium, against the fungal disease dry root rot of groundnut, (T_9 - *B. subtilis* (Bs_1) + *B. licheniformis* (Bl_3) + *P. fluorescens* (Pf_4) @ 10 ml/kg of seed) recorded the maximum control of dry root rot disease and increased the growth parameters of groundnut. The result of the present study has proved that application of the chitinolytic microbes as consortium, *B. subtilis* (Bs_1) + *B. licheniformis* (Bl_3) + *P. fluorescens* (Pf_4) @ 10 ml/kg of seed exhibited a general trend towards

greater suppression of fungal disease of dry root rot. In addition to disease control, better nutrient uptake, plant growth promotion, and enhanced crop yield was observed.

Keywords: Chitinolytic bacterial consortium, Groundnut, dry root rot and biocontrol.

INTRODUCTION

Groundnut (*Arachis hypogaea L.*) is the king of oil seed crop and popularly called as wonder nut and poor man's cashew nut. It is primarily utilized as seed as they are rich source of edible oils containing fat (40-50%), protein (20-50%) and carbohydrate (10-20%). Besides, several other important dietary components are also present in groundnut such as calcium, magnesium, phosphorus, zinc, iron, potassium, niacin, folacin, vitamin E, riboflavin and thiamine (Fabra *et al.,* 2010). Yield loss in groundnut is due to several biotic factors like weeds, pest, insects and diseases. Among the various Diseases, the fungal dry root rot is the major factor in yield reduction of groundnut. The dry root rot disease cause more than 55 per cent yield loss in groundnut under field condition. The use of fungicides, fungicides cause serious health problems. Chitinolytic microorganisms have been used as bio control agents for several crops with promising results. These chitinolytic microbes produced chitinase enzyme have received special attention due to their role in the bio control of fungal pathogens (Mathivanan *et al*., 1998). A variety of pathogenic microorganisms contain chitin coats which provide protection against external factors, and Chitinase have been employed to breakdown these protective coats and weaken the defense system of several pathogenic microorganisms and insects (Hamid *et al*.,2013). Further with this antagonistic advantage, this research was designed and conducted to isolate and characterize the chitinolytic bacteria from groundnut rhizosphere soil. The present study aims that the chitinolytic bacteria and their antagonistic effect as consortium against dry root rot of groundnut and to elucidate the reduction of mycelial growth.

MATERIALS AND METHODS

Isolation of Chitinolytic bacteria from groundnut rhizosphere soils

Chitinolytic bacteria were isolated from the rhizosphere soil samples collected from different groundnut growing areas of Tamil Nadu by serial dilution method on Nutrient agar medium, King's B medium for *Bacillus subtilis, Bacillus licheniformis* and *Pseudomonas fluorescens,* respectively by incubating at room temperature for 24 h. Colonies with characteristics of *Bacillus subtilis, Bacillus licheniformis* and *Pseudomonas fluorescens* were isolated individually and purified by streak plate method.

Biochemical characterization of Chitinolytic isolates

For the identification of *Bacillus* sp. and *Pseudomonas* sp. isolates, certain biochemical tests were conducted according to Bergey's manual for determinative bacteriology (Breed *et al.* 1989). The identified *Bacillus subtilis* isolates were designated as Bs_1 - Bs_5, *Bacillus licheniformis* isolates were designated as Bl_1 - Bl_5 and *Pseudomonas fluorescens* isolates were designated as Pf_1 - Pf_5.

Gram staining

Gram staining was carried out as per modified Huncke's method. The slides were viewed with the light microscope under oil-immersion. Gram positive bacteria appear violet and gram-negative bacteria appear pinkish red in colour.

Catalase test

Smear of 24 h old bacterial cultures were prepared on clean slide and covered with a few drops of three per cent hydrogen peroxide. Effervescence indicated the presence of catalase in the culture.

Voges-Proskaeur test

Forty – eight hours old culture was inoculated into five ml of the nutrient agar (NA) broth dispersed in test tubes. After an incubation period of seven days, 0.6 ml alpha naphthol solution (5% in 95% alcohol) and 0.2 ml 40 per cent aqueous solution of KOH were added to one ml of the culture. The mixture was shaken for few minutes and allowed to stand for two hours. A colour change indicates the positive test.

Methyl Red test

Forty – eight hours old culture was inoculated into five ml of the MRVP broth dispersed in test tubes. After incubation period of seven days, 5 drops of methyl red indicator were added. The mixture was shaken for few minutes and allowed to stand for two hours. A colour change indicates the positive test.

Estimation of IAA

IAA in the methanol fraction was determined by employing Salper reagent (Gordon and Paleg, 1957).

Fluorescent pigment production

The petri plate containing sterilized King's B medium were inoculated with the isolate of *Pseudomonas* sp. and incubated for five days and observed. Development of yellowish green, fluorescent pigment observed under UV light (366 nm) indicated positive results.

Compatibility test between selected chitinolytic bacterial isolates

Dual culture technique

Compatibility among *Bacillus subtilis, Bacillus licheniformis* and *Pseudomonas fluorescens* was tested by following was tested by following the dual culture technique (Dennis and Webster,1971).

Preparation of liquid formulation of Chitinolytic bacterial consortium

For the preparation of liquid formulation, the method suggested by Manikandan *et al.* (2010) was followed. The most effective isolate of *Bacillus subtilis* (Bs_1), *Bacillus licheniformis* (Bl_3) and *Pseudomonas fluorescens* (Pf_4) was inoculated individually into respective broth and incubated at room temperature (28 ± 2°C). Further, the respective broths were added with glycerol at 2 per cent level. After incubation period, the formulation was assessed for adequate CFU following serial dilution plating technique and the formulation thus prepared.

Seed treatment with different chitinolytic bacteria

Seed of groundnut were surface sterilized with two per cent sodium hypochlorite for 30 seconds, rinsed in sterile distilled water and dried overnight. Ten ml of chitinolytic consortium based formulated inoculums was taken in a Petri dish. To this, 100 mg of carboxy methyl cellulose (CMC) was added as an adhesive material. Seeds were soaked in chitinolytic consortium suspension for 2 h and air dried overnight in a sterile Petri dish.

RESULTS

Chitinolytic bacterial isolates were characterized morphologically and biochemically. The results were tabulated in Table - 1 and 2. The results of the gram reaction and biochemical tests performed for the identification of the isolates of *Bacillus* showed that all the isolates produced similar results with regard to gram staining (positive), catalase test (positive), anerobic growth (negative), VP test (negative) in case of *Bacillus subtilis* (positive) in *Bacillus licheniformis,* utilization of citrate was found to be (positive) in *Bacillus subtilis* and negative in *Bacillus licheniformis,* results of Methyl red test was positive in *Bacillus subtilis* and negative in *Bacillus licheniformis,* Gas formation was noticed in both species, hydrolysis of starch and gelatin was also positive in both species. (Table - 1). The identified *Bacillus subtilis* isolates were designated as Bs_1 - Bs_5 and *Bacillus licheniformis* isolates as Bl_1 - Bl_5. The results of the gram reaction and biochemical tests performed for the identification of the effective native isolates of *Pseudomonas* showed

that all the isolates produced similar results with regard to gram staining (negative), motility (positive), starch hydrolysis (negative), gelatin liquefaction (positive) and fluorescent pigmentation (positive). All the isolates showed positive results in IAA production. Among the isolates Pf_5 produced more quantity (3.6) of IAA followed by Pf_4, Pf_3, Pf_2 and Pf_1 (3.5, 3.4, 3.3 and 3.2, respectively) in the decreasing order of merit. Similarly, the isolate Pf_5 recorded maximum siderophore (0.88) production. All the isolates recorded positive results about hydrogen cyanide production (Table - 2). The identified isolates were designated as Pf_1 to Pf_5. The effect of different treatments of Chitinolytic bacteria against dry root rot disease of groundnut were assessed and presented in Table - 3. The effect of seed treatment with chitinolytic bacteria either individually or as combination showed significant influence on the incidence of root rot of groundnut when compared to control. Among the various treatments the treatment (T_9 - *B. subtilis* (*Bs_1*) + *B. licheniformis* (*Bl_3*) + *P. fluorescens* (*Pf_4*) @ 10 ml/kg of seed) recorded the minimum root rot incidence (8.62 %) which was on par with that of treatment (T_2 - Carbendazim 50%WP as seed treatment @4g/kg of seed (9.80 %). This was followed by the treatment with dual inoculation T_8 - *P. fluorescens* (*Pf_4*) + *B. subtilis* (*Bs_1*) @ 10 ml/Kg of seed (10.60 %), T_7 - *B. licheniformis* (*Bl_3*) + *P. fluorescens* (*Pf_4*) @ 10 ml/kg of seed (11.50 %) and T_6 - *B. subtilis* (*Bs_1*) + *B. licheniformis* (*Bl_3*) @ 10 ml/kg of seed (12.60). The individual treatment T_3, T_4 and T_5 also recorded 16.40 %, 14.50 % and 13.20 per cent dry root rot incidence, respectively. The maximum of 20.10 per cent was recorded in treatment T_1 (control). Means with same alphabets are statistically on par by Duncan's Multiple Range Test (DMRT) at 5% level.

CONCLUSION

In most research to date, bio control agents were applied singly to combat a pathogen. But the results of the present study have proved that application with combination of bio control agents *viz.,* B. *subtilis* (*Bs_1*) + *B. licheniformis* (*Bl_3*) + *P. fluorescens* (*Pf_4*) @ 10 ml/kg of seed exhibited a general trend towards greater suppression of fungal disease in groundnut such as dry root rot caused by *Macrophomina phaseolina.* In addition to disease control, better nutrient uptake, plant growth promotion and enhanced crop yield as observed in the present study adds another advantage over the use of fungicides in disease management strategies.

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Table - 1. Biochemical Characterization - *Bacillus* sp.

Sl.No	Parameters	Isolates of *Bacillus subtilis*					Isolates of *Bacillus licheniformis*				
		Bs_1	**Bs_2**	**Bs_3**	**Bs_4**	**Bs_5**	**Bl_1**	**Bl_2**	**Bl_3**	**Bl_4**	**Bl_5**
1.	Gram Stain	+ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve
2.	Catalase test	+ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve
3.	Anaerobic growth	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve

4.	Vogas Proskaeurs test	-ve	-ve	-ve	-ve	-ve	+ve	+ve	+ve	+ve	+ve
5.	Utilization of Citrate	+ve	+ve	+ve	+ve	+ve	-ve	-ve	-ve	-ve	-ve
6.	Methyl Red Test	+ve	+ve	+ve	+ve	+ve	-ve	-ve	-ve	-ve	-ve
7.	Gas formation in Glucose broth	+ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve
8.	Hydrolysis of Starch	+ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve
9.	Hydrolysis of Gelatin	+ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve

Table - 2. Biochemical Characterization - *Pseudomonas fluorescens*

Sl. No	Parameters	Isolates of *Pseudomonas fluorescens*				
		Pf_1	**Pf_2**	**Pf_3**	**Pf_4**	**Pf_5**
1.	Gram Staining	-ve	-ve	-ve	-ve	-ve
2.	Motility	+ve	+ve	+ve	+ve	+ve
3.	Starch Hydrolysis	+ve	+ve	+ve	+ve	+ve
4.	Gelatin liquefaction	+ve	+ve	+ve	+ve	+ve
5.	Fluorescent Pigment	+ve	+ve	+ve	+ve	+ve
6.	Egg Yolk Test	-ve	-ve	-ve	-ve	-ve
7.	Estimation of IAA μg/ml	3.3	3.4	3.2	3.5	3.6
8.	Siderophore production (Hydroxamate)	0.86	0.83	0.84	0.82	0.88
9.	Hydrogen Cyanide production	8.12	8.05	8.11	8.14	8.12

Table - 3. Effect of Seed Treatment with Chitinolytic Bacterial Consortium against Dry root rot Disease Incidence in Groundnut

Tr.No	Treatments	Root rot incidence (%)				Mean
		25 DAS	**50 DAS**	**75 DAS**	**At harvest**	
T_1	Control	15.25^{g}	18.35^{g}	21.25^{g}	25.35^{e}	20.10^{h}
T_2	Carbendazim 50%WP as seed treatment @4g/kg of seed	5.10^{a}	8.30^{b}	11.70^{b}	14.10^{b}	9.80^{b}
T_3	*Bacillus subtilis* (Bs_1) @ 10 ml/kg of seed	12.40^{f}	14.70^{f}	17.55^{f}	21.10^{d}	16.40^{g}
T_4	*Bacillus licheniformis* (Bl_3) @ 10 ml/kg of seed	10.70^{e}	12.90^{f}	15.40^{e}	19.10^{d}	14.50^{f}
T_5	*Pseudomonas fluorescens* (Pf_4) @ 10 ml/kg of seed	9.80^{d}	11.70^{e}	12.60^{c}	18.50^{c}	13.20^{e}
T_6	*B. subtilis* (Bs_1) + *B. licheniformis* (Bl_3) @ 10 ml/kg of seed	8.40^{d}	10.60^{d}	13.50^{d}	17.70^{e}	12.60^{d}
T_7	*B. licheniformis* (Bl_3) + *P. fluorescens* (Pf_4) @ 10 ml/kg of seed	7.50^{c}	9.60^{c}	12.70^{c}	16.30^{c}	11.50^{c}
T_8	*P. fluorescens* (Pf_4) + *B. subtilis* (Bs_1) @ 10 ml/kg of seed	6.60^{b}	8.75^{b}	11.68^{b}	15.25^{b}	10.60^{b}
T_9	*B. subtilis* (Bs_1) + *B. licheniformis* (Bl_3) + *P. fluorescens* (Pf_4) @ 10 ml/kg of seed	4.30^{a}	7.60^{a}	10.40^{a}	12.20^{a}	8.62^{a}

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REVIEW ARTICLE

A Review on Clinical Studies of *Apamarga kshara pratisarana,* a Multifaceted *Anu shastra* in *Gudaja Vikaras*

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ABSTRACT

The aim of the study was to review the efficacy of *Apamarga kshara* used in different *Gudaja vikaras* (anal diseases). The review of Clinical study using *Apamarga kshara*in different anal diseases was carried out. Extensive searches were made using the search engines like Google Scholar, PubMed, DHARA and also the thesis conducted in ITRA, Jamnagar. The review was also carried from different journals also. Eight articles were reviewed in which *pratisarana* with *Apamarga kshara* was done exclusively to treat different ailments of *Guda*

Keywords: *Apamarga kshara*in, PubMed, conducted in ITRA, *Guda pratisarana.*

INTRODUCTION

Kshara karma and Agni karma therapy have been identified as para-surgical measures having minimal invasive procedures. These procedures have many advantages like-simple, safe, effective, ambulatory and known for minimal or no complications, less time to stay in the hospital and minimal disturbance in patient's routine work. That's why it is readily acceptable to patients. Shalya Chikitsa particularly from the area of Para-surgery has been selected. Under the heading of para-surgery, *Kshara karma* procedure interpreted to potential cauterization application therapy is the specific field taken in to research for finding out the better approach in comparison to the modern counterpart. In relation to *Kshara Karma, Sushruta* has advocated *Kshara pratisaran,* which is a quite relevant method for the cases of Anal diseases. Captivating in to consideration of above all factors, planned to review the effect of *Apamarga kshara pratisaran* in different *Gudaja Vikaras* selected.

Effectiveness in Hyper granulation after fistulectomy:

The case study revealed the effectiveness of *Apamarga kshara pratisarana* in the treatment of Hypergranulation of the tissue after fistulectomy. The *Pratisarana* was done for 100 Matras. The *Pratisarana* done for 3 days. The study revealed that after 7 th day, the patient was free from inflammation. Study concluded that *Apamarga kshara* application has the potential to scraped out the unhealthy granulation tissue by its Lekhana property, which later on provided the healthy floor of the wound to recovered. It is a very minimal invasive procedure, within a very minimum time and complete eradicated of the unhealthy tissue. This single case study shows very encouraging result in case of unhealthy granulation tissue in the wound.

Effectiveness in Nadi Vrana (Pilo Nidal Sinus):

In group A (n=10) total excision of sinus tract followed by local application of *Apamarga kshara* plota (swab). In group-B (n=07) partial excision /erudition of tract and then application (threading) *Apamarga ksharasutra.* The procedure has been conducted as per the need of anesthesia that is spinal anesthesia was used in 10 cases while local anesthesia was used in 07 patients. The dressing with *Kshara* plot was continued and there was complete debridement of fibrotic tissue with mild slough within seven days. Dressing continue and wound became clean and wound contraction was noted remarkable. The post operative wound was healed completely within 4 weeks.

Group A:

Jack knife position, lateral position and prone position was given as per comfort of patient. Painting with antiseptic lotion and draping was done. A probe director is inserted into the cavity of the sinus and it is laid open completely along with its length. All diverticulitis were dissected and then all nests of hairs and debris were removed completely. Under this procedure all the cavities of sinuses were explored and cleaned. Bleeding points were clamped by the artery forceps. It is most important that the *Kshara* plota (Caustic swab) is applied immediately after removing the artery forceps one by one. If some points bleed, then, concentrated *Kshara* lotion or cautery was used as per requirement. After half an hour caustic swab is removed followed by the pressure dressing with packing of gauze dipped in *Kshara* ointment.

Group-B:

KST (*Ksharasutra* Threading) Due painting and draping was done with required materials. The route/routes of sinus with the cavity were traced by probing. Then partial erudition superficially up to un invaded of fibrous tissue was done in order to making way/ways for well debridation /discharge of the debris, from the sloughed and fibrosis part, following to clean up of all the hairs of nest and debris in complete form on possible ways from the cavity of pilonidal sinus. There after the *Apamarga ksharasutra* threading was tied just touching the two ends through the tract without any pressure in single and multiple sinus tracts in one sitting. Dressing was undertaken and light superficial bandage was applied. Out of 07 cases only 02 cases had multiple sinuses with tracts whereas rest cases were having the single tract. Under Potential Cauterization Agents therapy therapy, integration type of treatment has been proved better result and in maximum follow up cases it has been observed that the reoccurrence rate is quite negligible. The *Apamarga kshara* Application given the as the effective method for this.

Effective in Internal Haemorhoids:

1. Bijendra Shah et al: In this study, 33 patients who underwent Ksharakarma for the treatment of piles for first time in the year 2014 to 2015. Among them, 29 patients Kshara karma was done once and in 4 patients due to larger size of pile mass we did Kshara Karma twice. Clinical features of all patients were assessed weekly for four weeks. Every six month after treatment the inquiry was done by telephone about recurrence. Ksharakarma-Kshara application was done in operation theatre (OT) by adopting Trividha Karma. After Kshara application, all patients were followed up weekly for 4 weeks. During each follow-up visit relief in signs and symptoms were assessed. There was moderate to mild pain, tenderness, inflammation and brownish black discharge on first visit and second visit. During the third visit, there was no pain, tenderness, discharge or anal stricture and the internal hemorrhoids had completely resolved. Ksharakarma shows significant improvement on clinical features of Arsha like rectal bleeding, pain in ano

and constipation. In overall effect of therapy by Ksharakarma showed 69.7% of the patient got cured or complete remission of symptoms. Average time taken for complete remission of pile mass was 21 days by Ksharakarma without bleeding, pain. 2. Swarup Majumder et al: Totally 40 patients of internal hemorrhoids had been selected for the study and those are divided into two groups, Group A - 20 patients and Group B - 20 patients. Complete history and clinical evaluation of all the patients had been recorded in a specially designed Performa which included both Ayurvedic and modern methods of examinations. Subjective and objective parameters were used to assess the clinical response in both groups. The patient was assessed on before treatment (1st day), on 7th day, on 14th day on 21st day after the treatment. Group A - Saptacchada *Pratisaraniya kshara*. Group B - *Apamarga pratisaraniya shara.*The study showed that Group A and Group B are equally effective. The treatment modalities of Saptacchada *Pratisaraniya kshara karma* and *Apamarga Pratisaraniya Kshara Karma* are equally efficacious in treating Arshas.

Effective in Fistula in Ano

Monica Shrestha et.al: A 43 years old male patient visited OPD with throbbing pain in ano, swelling and fever with chills. On examination external opening was seen at 11 o'clock approximately 4 cm from anal verge with abscess. TRUS (Transrectal Ultrasonography) was done to confirm the diagnosis. Patient had history of surgery before 2 years for drainage of perianal abscess. So, it was diagnosed as a case of perianal abscess with intersphicteric low anal fistula. Chedana (fistulectomy) followed by teekshna *Apamarga kshara* application under spinal anesthesia (Xylocaine 2% with adrenaline) was done. Observation And Results: The wound was assessed weekly and it was observed that in first week pain was reduced completely. On second week healthy granulation was observed without any discharge. The wound healed completely within one and half month with minimal scar formation and normal skin coloration. This single case study concluded that Chedana (fistulectomy) with *Ksharkarma* is one of the option for management of low anal fistula.

CONCLUSION

Considering all the utility of *Apamarga Kshara Pratisarana* in the above studies underlines the *Apamarga Kshara* is a multifaceted *Anushastra* in the management of *Gudaja Vikaras*.

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Table 1 Effectof Apamarga KsharaPratisaran indifferent *GudajaVikaras* selected.

S. No.	Name of Disease/Condition	Groups	*KsharaKarma*	OtherMedication/Procedure	Conclusion
1.	**Post FistulectomyHyper granulation[1]**	Single Case Study	***Pratisarana*(*Apamarga Kshara*** on hyper ganulation tissue was kept in situ for minimum100*Matra*(approx-2minutes).Then the site was rinsed with lime water to	sitzbath with *Pancavalkal Kwatha*t wice daily. *Triphala Guggulu*(500mg)2 Tabthreetimesaday	It was observed that the un healthy granulation was totally disappeared on the3nd day of dressing. The *Kshara* application and dressing was continued and on 7th day patient was free from inflammation,
			neutralized,and thewoundwaspacked withjatyaditailagauze piece.)	with lukewarm water. Erandbhrishthaharitaki5gmatnight withlukewarmwater.	tenderness and hyper granulated wound
2.	**Nadivrana2 (Pilonidalsinus)**	GroupA10 Group B07	In group-A, total excision of sinus and then applied the Apamarga Ksharaplota (Kshara swab)locally, In group-B rest7cases were treated with partial erudition of tract and applied the Ksharasutra	Arogya Rasayan tablet of 250 mg three times a day in 15 patients of both groups postoperatively for a period of six weeks. Jatikalp Ghrita Ointment For external application	The duration of treatment in 15completecuredcaseswere noted from, 10 patientsingroup– Ahadtaken2weeks-14days . 05patients in group-B hadtaken4weeks-28dayswhile In 2 complicated, deep and long sinus cases in group - Btaken9weekstocompletecure.

3.	**Internal Hemmorrhoids3**	33 patients having haemorrhoids with complaints of mass protrusion, pain and bleeding perrectal of different grade(1st, 2nd, 3rddegree)	The Ksharawas applied on proposedlesion by spatula and was kept on piles mass up to the counting 100 that is1-2 minutes	Shigruguggulu 1g thricedaily Jathyadi Ghrita Application Jathyadioil Enema Avagaha with Sphatika Toya.	69.7 % complete remission15.1%markedimprovement 9.1 %improvement 6.1 % were absent in follw up
4.	**Fistulain Ano4**	AsingleCaseStudy	The tract was excised(Chedana)and Teekshna Apamarg Kshara was applied then covered by agauze piece and left for approximately 30seconds, later flushed with lemon juice followed by normal saline.	Jatyadi TailaMatra basti.Varun shrigruguggulu 1gmthrice daily. Sitz bath with *Panchavalkala Kwatha.*	The wound was assessed weekly and it was observed that in first week pain wasreducedcompletely.Onsecondweekhealthygranulationwasobservedwithoutany discharge. The wound healed completely within one and half month with minimal scar formation and normal skin coloration.
5.	**Fissure inAno5**	Total Patients60 GroupA:30Group B:30	In group-A, patients were undergone by Kshara application; *Apamarga Kshara* was applied on fibrosed fissure grovelocally kept for 100sec. The changes were noted. while in patients of Group-B	Sitz Bath with Sphatikadi Yogatwotimes daily Panch sakarChurna5gm atbedtime.	The symptom pain, bleeding and spasm were relieved in both group sequally. But healing of ulcer was found significant in fissur ectomy group than *Kshara* application
			Lord'sanaldilatation followed by fissur ectomy was done under spinal anaesthesia. The wound was treated for 4 weeks and assessment of the result was done on the basis of gradation adopted		

6.	**Internal Hemmorhoids6**	Totally 40patients Group A - 20patients and Group B - 20patients.	Group A - Saptacchada *PratisaraniyaKshara.* Group B - *ApamargaPratisaraniya Kshara.*	----------	Clinically there is no difference in the effect between the two groups except in pain after *Kshara Karma* where *Apamarga Pratisaraniya Ksharafared* better which may be becauseof action of *Vata-Kaphahara* and Ushna Virya property of *Apamarga,* bleeding peranum was also less in *Apamarga Kshara* comparedto Saptacchada Kshara. Patients of both the groups were co-operative, with stood the procedure well and there was better acceptability in the group treated with Apamarga Pratisaraniya Kshara Karma because of less pain suffered from the patients when compared to the group treated with Saptacchada *Pratisaraniya Kshara Karma.* No recurrence was observed in both the groups after in the follow-up period.
7.	**1st and 2nd degree hemorrhoids**	Total 30patients Group A :10Group B : 10GroupC:10	Group A: *Apamarga Kshara* application Group B: IRC was applied at the baseof piles Group C :*Arshohara* vati 2tablets thrice a dayfor15 days	----------	The study concluded that *Apamarga Kshara* application is the most effective treatment for the management of internal haemorrhoids
8.	**1st and 2nd degree piles10**	Total 50patients	Group A :*ApamargaTikshna*		The study concluded that *Apamarga Kshara*
		Group A : 25GroupB: 25	*Kshara* application was done GroupB: Sclerotherapy was done		application is effective procedure of choice for the management of 1stand 2nd degree internal piles as compared to sclerotherapy.

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RESEARCH ARTICLE

Ecological Studies on Riparian Vegetation in the Lower Stretches of Chaliyar River, Kerala, India

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ABSTRACT

The Riparian zones are the most species-rich habitats on the terrestrial portion of the earth. These are the connecting link between terrestrial and aquatic ecosystems. There are many threatened factors that affect the distribution and diversity of vegetation in the riparian zone. The present investigation deals with the Ecological studies on the riparian vegetation of Chaliyar river lower stretches on the basis of the nested quadrat method. The lower stretch of the river is divided into 10 sampling plots and extensive field observation and data collection were conducted. There are about 72 plant species belonging to 36 families were documented. The Importance value index of the study area shows that the *Alstonia scholaris* is the dominant species among trees followed by *Mikania micrantha* among climbers. Abundance – Frequency ratio shows that most of the member's dispersion pattern is contagious; it is the most common dispersion pattern in nature. The species diversity index value of the study area lies within the range of Tropical forests in India.

Keywords: Chaliyar, Ecology, Importance value index, Riparian, Vegetation.

INTRODUCTION

River margins are greater biodiversity-rich areas and the vegetation seen along the riverside's is commonly referred to as the riparian vegetation. The riparian areas are the transition zone between aquatic and terrestrial ecosystem [1]. Riparian species assemblages and composition of an area forms a significant habitat that determines and contributes

to the structure and function of an ecosystem [2]. The riparian zone is occupied neighbouring to the rivers, streams, ponds, lakes, wetlands etc. and has a impact on the wildlife and aquatic habitat. Riparian ecosystems are the most fruitful, species-rich and susceptible to various anthropogenic disturbances [3]. Riparian landscapes are highly exposed ecosystems as they are innately exceptional habitats, occupying a large portion of species diversity of the Earth's surface [4]. Chaliyar river riparian zones are one of the most species rich and diverse regions compared to other rivers of Kerala. It is the fourth longest river and there exists a very little valid quantitative ecological information about riparian vegetation in relation to species diversity of Kerala watersheds. Flood heavily affected the biodiversity of Chaliyar. In addition to these Landslides, landslips, Urbanization, Sand mining etc destruct the vegetation; along with this anthropogenic activities also severely affected the vegetation along the Riverside. This work seeks to evoke interest in various experts to study about riparian vegetation and diversity which will in turn results in conservation and understanding of the same. The present study deals with the ecological studies and diversity analysis of plant species from 10 different sampling sites along the riparian regions of lower stretches of Chaliyar River.

MATERIALS AND METHODS

Study area and Documentation of Plants

The documentation was mainly based on the field observation as well as the collection of plant species along the Chaliyar Riparian zones (Fig,1). For the collection of plants 10 different plots are selected on either sides of Chaliyar River in a stretches of 30 km from Beypore to Edavannapara (Table -1). The plots are selected based on the accessibility, vegetation diversity, proximity to the river etc. After the collection, the plants were identified by the use of different Floras like Flora of Presidency of Madras [5], Flora of Calicut [6], Flora of British India [7] and The plants were photographed using Nikon D 5300 camera. The specimens were processed for the preparation of Herbarium by standard methods [8, 9, 10].

Sampling study sites and Vegetation Analysis

The present study was conducted during the period of 2020 – 2021. The vegetation analysis was carried out by nested quadrats methods by laying 10 x10 m quadrats for trees; 5x5 m for shrubs and climbers, and 1x1m for herbs. In every quadrat of 10 x 10 m trees species were enumerated and for all trees girth is measured about 1.37 m from the ground that is girth at breast height (gbh)is recorded. Quadrat data were used for computation of analytical features such as density, frequency, abundance, basal cover, and Importance Value Index (IVI), following standard phytosociological methods [11].

$$\text{Density} = \frac{\text{Total no. of individuals of a species}}{\text{Total no. of quadrates studied}}$$

$$\text{Relative density (\%)} = \frac{\text{Number of individuals of a species}}{\text{Number of individuals of all species}} \times 100$$

$$\text{Frequency} = \frac{\text{Number of sampling units species occur}}{\text{Total number of sampling units}} \times 10$$

$$\text{Relative frequency (\%)} = \frac{\text{Frequency of a species}}{\text{Frequency of all species}} \times 100$$

$$\text{Abundance} = \frac{\text{Total no. of individuals of a species}}{\text{Total no. of quadrates in which the species occurred}}$$

Relative Basal Area (%) = $\frac{\text{Basal area of a species}}{\text{Basal area of all the species}} \times 100$

Basal area of trees was calculated by using the formula:

Basal area = $\frac{C^2}{4\pi}$

where, C = Girth at breast height

The IVI for Trees was determined as the sum of Relative density, Relative frequency and Relative basal area where as for herbs and shrubs it was determined as the sum of the Relative density, Relative frequency, and Relative dominance [12]. Species distribution pattern was examined through abundance/frequency (%) ratio [13] and it was categorized into regular (≤ 0.025), random (0.025–0.05), and contagious (≥ 0.05).
Simpson's index D was calculated by the formula as $D= \Sigma (pi)^2$ formulated by Simpson[15].
Shannon index (H) was computed from the formula as $H = -\Sigma (pi \log pi)$.
Simpson's Index of Diversity (1949) = 1-D
Simpson's Reciprocal Index =1/D

RESULTS AND DISCUSSION

Floristic Diversity of The study area

There are about 72 species belongs to 36 families were documented (Table - 2). Analysis of dominant families in the study area reveals that the Asteraceae is the dominant family with 9 species followed by Fabaceae with 7 species, Poaceae with 6 species, Euphorbiaceae and Verbenaceae with 4 species respectively.

Life Form Analysis

The life form analysis of the documented riparian plants in the study area reveals that, herbs are domiant (33 Nos.), followed by shrubs (17 Nos.), trees (17 Nos.) and climbers (5 Nos.) (Fig. 2).

Importance Value Index (IVI)

Importance Value Index is a measure of how dominant a species is in a given area. Calculations of IVI have helped in understanding the ecological significance of the species in the respective vegetation types. Among the tree species, *Alstonia scholaris* (25.12) and *Ficus religiosa* (21.40) showed highest importance value index compared to other tree species in the study area. The least Importance value index is showed by *Prosopis juliflora* (1.37) and *Leea indica* (1.90) among the tree members in the study area (Fig.3). *Mikania micrantha* (7.97), *Chromolaena odorata* (6.86) and *Sida cordifolia* (6.64) exhibits highest IV, whereas *Abrus precatorius* (1.36) and *Flemingia macrophylla* (1.36) showed lowest IV among Shrubs and climbers. *Cynodon dactylon* (28.77), *Chloris barbata* (17.46) and *Aerva lanata* (12.48) showed highest IVI and *Lygodium flexosum* (1.36) and *Xanthium indicum* (1.36) showed lowest IVI among Herbs (Fig. 4) (Table - 3).

Abundance / Frequency Ratio (A/F) and Dispersion Pattern

The abundance to the frequency ratio ranged from 0.013 to 0.6 in the study area (Table - 3). Among the tree members 8 species shows value more than 0.05, ie, the dispersion pattern is contagious. Contagious distribution is the most common type of dispersion found in nature. In this the distance between neighboring individuals is minimized. This type of distribution is found in environment that is characterized by patchy resources. 6 species of trees have value less than 0.025 and they show regular distribution pattern. Regular distribution is less common compared to contagious distribution pattern; here the distance between individuals is maximized. The remaining 3 species show random distribution pattern. The Random distribution pattern is the least common form of distribution in nature and occurs when the members of a given species are found in

environments in which the position of each individual is independent of the other individuals. Dispersion pattern of herbs and shrubs showed that 30 species have value more than 0.05 and are exhibit contagious pattern of distribution. 13 species shows regular pattern of distribution and 12 species value ranges from 0.025 to 0.05 so they are exhibit random pattern of distribution (Fig. 5) (Table - 3).

Species Diversity Index

Species diversity was calculated using different diversity indices. The value of Shannon–Wiener diversity index in the present study ranged from 2.30 to 3.28 (Table - 4). The diversity index for Indian forests ranged between 0.83 and 4.1 [15]. The value of diversity index of the present study, there for, Lies within the range reported for tropical forests. Neither species richness nor species density alone in isolation is considered to be the complete and comprehensive method for measuring diversity. However, patterns of diversity are sensitive and reflect the measure used [16]. Tree species diversity in tropical areas varies greatly from place to place mainly due to variation in biogeography, habitat, and disturbance [17]. In Southeast Asia, the highest richness recorded so far is 255 species per hectare [18]. There is a high species diversity can be seen in the lower stretch of riparian region of Chaliyar River. The highest Shannon–Wiener diversity index was recorded in Oorkkadavu region (3.28) it is located in the middle of the lower stretch of the river. The lowest Shannon–Wiener diversity index was recorded in Feroke region (2.30). It denotes that the Oorkkadavu region is more diverse than the remaining selected areas and feroke region is least diverse. The range of value indicates that there is no drastic variation can be seen among the species diversity of riparian vegetation in the lower stretch of Chaliyar River.

The diversity index(H') for some of the Indian riparian forest were 3.06 [19] 5.6 [20], 1.43-1.84 [21], 2.19-2.92 [22] and 2.43-5.4 [23]. Flooding events are primarily responsible for creating its spatial heterogeneity, with the timing of flooding, its duration, frequency, and magnitude all identified as influencing the structure and composition of riverine vegetation [24, 25, 26]. Simpson's Diversity Index is a measure of diversity which takes into account the number of species present, as well as the relative abundance of each species. As species richness and evenness increase, so diversity also increases. Simpson's diversity index (D) lies within the range of 0.04 to 0.15. Simpson's index of diversity (1-D) lies within the range of 0.84 to 0.95 and Simpson's reciprocal index (1/D) lies within the range of 6.45 to 24.24 (Table - 4). The value obtained for Simpson diversity index in present study is less than the value reported by Bachan [21]which lie s within the range 0.94 -1.00 from the riparian vegetation along the middle and lower zones of the Chalakkudy river, Kerala, India . Indicating less number of tree diversity in the studied zones. Sunil et al.[27] recorded Simpson's index value of 0.96 in riparian vegetation across forest of river Cauvery southern, India. Iqbal et al. [19] obtained Simpson's index value of 0.08 of trees growing along the Khoh river of Garhwal Himalaya, India, and Vincy *et al.* [28]reported the range of 0.12 to 0.67 in her studies on the comparison of riparian species diversity between the main river channel and sub watersheds of Meenachil river basin.

Basal Area

The basal area of the tree members in the study area ranges from 0.85 to 26.86. *Alstonia scholaris* have a gbh of 185cm shows highest basal area (26.86). Whereas Prosopis juliflora have gbh of 33 cm shows the lowest basal area (0.85) (Table - 5). This indicates that if girth at breast height is more the basal area is also proportionally increases. Density of the trees with smaller girth size is higher than that of the larger girth size [29].

CONCLUSION

The Ecological studies of the Riparian floristic elements in the lower stretches of Chaliyar River, Kerala, based on the nested quadrat studies reveals that, there are about 72 floristic elements present in the study area. Herbaceous plants are dominant over shrubs and trees. Asteraceae is the dominant family consists of 9 species. *Alstonia scholaris* (25.12) is the dominant species in the given area and it showed highest importance value index compared

to other tree species in the study area. Contagious distribution pattern is more in the study area because the Abundance and frequency ratio is more than 0.05 for most of the members. Shannon–Wiener diversity index value in the present study ranged from 2.30 to 3.28. Some of the threatened factors like fast rate of biotic interference, destruction of natural habitat by human interference, invasion of some exotic weeds like *Mikania micrantha* and unsustainable utilization of natural resources may adversely affect the existing diversity of plants of these Riparian regions. Hence the present study also highlights the importance for the conservation of riparian floristic elements from various threatening factors which are imposed to them.

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Table - 1 Sample Plots of Study Area

Sl. No.	Location	Latitude	Longitude
1	Beypore	11.1736° N	75.8040° E
2	Feroke	11.1735° N	75.8352° E
3	Azhinjilam	11.2001° N	75.8665° E
4	Vellaykkode	11.2178° N	75.8736°E
5	Oorkkadavu	11.2463° N	75.9237° E
6	Vazhakkadu	11.2535° N	75.9724° E
7	Edavannapara	11.2448° N	75.9775° E
8	Murinjamadu	11.2744° N	75. 9785°E
9	Mavoor	11.2675° N	75.9425° E
10	Areekkode	11.2324° N	76.0518° E

Table - 2 List of Collected Plant Species and their Families

Sl No.	Botanical Name	Family		Botanical Name	Family
Tress					
1	*Adenanthera pavonia*	Fabaceae	*37*	*Sida acuta*	Malvaceae
2	*Albizia saman*	Mimosaceae	*38*	*Sida cordifolia*	Malvaceae
3	*Alstonia scholaris*	Apocyanaceae	*39*	*Urena lobata*	Malvaceae
4	*Areca catechu*	Arecaceae	**Herbs**		
			40	*Acalypha indica*	Euphorbiaceae
5	*Cocos nucifera*	Arecaceae	*41*	*Alternanthera bettzickiana*	Amaranthaceae
6	*Cycas circinalis*	Cycadaceae	*42*	*Aerva lanata*	Amaranthaceae
7	*Ficus religiosa*	Moraceae	*43*	*Blumea axillaris*	Asteraceae
8	*Gliricidia sepium*	Fabaceae	*44*	*Boerhavia diffusa*	Nyctaginaceae
9	*Leea indica*	Leeaceae	*45*	*Chloris barbata*	Poaceae

10	*Macaranga peltata*	Euphorbiaceae	*46*	*Cleome viscose*	Cleomaceae
11	*Mangifera indica*	Anacardiaceae	*47*	*Cyanotis cristata*	Commelinaceae
12	*Prosopis juliflora*	Mimosaceae	*48*	*Cynodon dactylon*	Poaceae
13	*Tectona grandis*	Verbenaceae	*49*	*Dactyloctenium aegyptium*	Poaceae
14	*Terminalia catappa*	Combretaceae	*50*	*Desmodium triflorum*	Fabaceae
15	*Sterculia guttata*	Sterculiaceae	*51*	*Eclipta prostrata*	Asteraceae
16	Swietenia mahagoni	Meliaceae	*52*	*Eleusine indica*	Poaceae
17	*Ziziphus mauritiana*	Rhamnaceae	*53*	*Eragrostis tenella*	Poaceae
Shrubs & Climbers			*54*	*Euphorbia hirta*	Euphorbiaceae
18	Abrus precatorius	Fabaceae			
19	Cardiospermum halicacabum	Sapindaceae	*55*	*Glinus oppositifolius*	Molluginaceae
20	*Calopogonium mucunoides*	Fabaceae	*56*	*Heliotropium indicum*	Boraginaceae
21	*Calotropis gigantea*	Asclepiadaceae	*57*	*Leucas aspera*	Lamiaceae
22	*Chromolaena odorata*	Asteraceae	*58*	*Lindernia crustacea*	Linderniaceae
23	*Clerodendrum inerme*	Lamiaceae	*59*	*Ludwigia perennis*	Onagraceae
24	*Clerodendrum infortunatum*	Lamiaceae	*60*	*Lygodium flexuosum*	Schizaceae
25	*Crotalaria rusta*	Fabaceae	*61*	*Mimosa pudica*	Mimosaceae
26	*Flemingia macrophylla*	Fabaceae	*62*	*Ocimum americanum*	Lamiaceae
27	*Glycosmis pentaphylla*	Rutaceae	*63*	*Oldenlandia corymbose*	Rubiaceae
28	*Hemidesmus indicus*	Periplocaceae	*64*	*Persicaria glabra*	Polygonaceae
29	*Ixora coccinea*	Rubiaceae	*65*	*Pouzolzia zeylanica*	Urticaceae
30	*Lantana camara*	Verbenaceae	*66*	*Pennisetum polystachyon*	Poaceae
31	*Mikania micrantha*	Asteraceae	*67*	*Scoparia dulcis*	Plantaginaceae
32	*Mussaenda frondosa*	Rubiaceae	*68*	*Synedrella nodiflora*	Asteraceae
33	*Passiflora foetida*	Passifloraceae	*69*	*Tridax procumbens*	Asteraceae
34	Rauvolfia tetraphylla	Apocyanceae	*70*	*Vernonia cinerea*	Asteraceae
35	Ricinus communis	Euphorbiaceae	*71*	*Wedeliachinensis*	Asteraceae
36	*Senna tora*	Ceasalpiniaceae	*72*	*Xanthium indicum*	Asteraceae

Table - 3 IVI, Abundance And Frequency Ratio And Dispersion Pattern

Plant Species	IVI	A/F	Dispersion Pattern
Adenanthera pavonia	2.24	0.05	Random
Albizia saman	15.63	0.024	Regular
Alstonia scholaris	25.12	0.05	Contagious
Areca catechu	6.63	0.06	Contagious
Cocos nucifera	11.72	0.025	Regular
Cycas circinalis	3.42	0.05	Contagious
Ficus religiosa	21.40	0.05	Contagious
Gliricidia sepium	10.19	0.028	Random
Leea indica	1.90	0.1	Contagious
Macaranga peltata	4.89	0.024	Regular
Mangifera indica	9.17	0.033	Random
Prosopis juliflora	1.37	0.1	Contagious
Sterculia guttata	5.77	0.1	Regular
Swietenia mahagoni	3.38	0.05	Contagious

Terminalia catappa	4.58	0.025	Regular
Tectona grandis	8.74	0.02	Regular
Ziziphus mauritiana	2.03	0.05	Contagious
Abrus precatorius	1.36	0.1	Contagious
Cardiospermum halicacabum	4.77	0.019	Regular
Calopogonium mucunoides	3.22	0.025	Regular
Calotropis rustacea	4.19	0.024	Regular
Chromolaena odorata	6.86	0.013	Regular
Clerodendrum inerme	1.36	0.1	Contagious
Clerodendrum infortunatum	4.45	0.016	Regular
Crotalaria rusta	3.22	0.025	Regular
Flemingia macrophylla	1.36	0.1	Contagious
Glycosmis pentaphylla	3.83	0.02	Regular
Hemidesmus indicus	1.98	0.05	Contagious
Ixora coccinea	1.98	0.05	Contagious
Lantana camara	3.83	0.02	Regular
Mikania micrantha	7.97	0.017	Regular
Mussaenda frondosa	2.60	0.033	Random
Passiflora foetida	4.38	0.043	Random
Rauvolfia tetraphylla	1.98	0.05	Contagious
Ricinus communis	1.76	0.1	Contagious
Senna tora	3.83	0.02	Regular
Sida acuta	2.55	0.075	Contagious
Sida cordifolia	6.64	0.052	Contagious
Urena lobata	3.13	0.1	Contagious
Acalypha indica	3.99	0.037	Random
Alternanthera bettzickiana	5.99	0.020	Regular
Aerva lanata	12.48	0.048	Random
Blumea axillaris	3.83	0.02	Regular
Boerhavia diffusa	4.54	0.028	Random
Chloris barbata	17.46	0.126	Contagious
Cleome viscosa	3.60	0.031	Random
Cyanotis cristata	4.38	0.043	Random
Cynodon dactylon	28.77	0.304	Contagious
Dactyloctenium aegyptium	4.85	0.175	Contagious
Desmodium triflorum	6.15	0.12	Contagious
Eclipta rustacea	2.60	0.033	Random
Eleusine indica	7.50	0.153	Contagious
Eragrostis tenella	7.73	0.3	Contagious
Euphorbia hirta	1.98	0.05	Contagious
Glinus oppositifolius	3.70	0.125	Contagious
Heliotropium indicum	1.98	0.05	Contagious
Leucas aspera	2.55	0.075	Contagious
Lindernia rustacean	2.80	0.033	Random
Ludwigia perennis	3.22	0.025	Regular
Lygodium flexuosum	1.36	0.1	Contagious
Mimosa pudica	3.02	0.043	Random
Ocimum americanum	1.36	0.1	Contagious

Oldenlandia corymbosa	4.38	0.043	Random
Persicaria glabra	3.70	0.125	Contagious
Pouzolzia zeylanica	2.55	0.075	Contagious
Pennisetum polystachyon	6.10	0.6	Contagious
Scoparia dulcis	1.98	0.05	Contagious
Synedrella nodiflora	3.13	0.1	Contagious
Tridax procumbens	2.55	0.075	Contagious
Vernonia cinerea	2.60	0.033	Random
Wedelia chinensis	4.85	0.175	Contagious
Xanthium indicum	1.36	0.1	Contagious

Table - 4 Species Diversity Indices of Plants

Diversity Indices	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**	**Plot 6**	**Plot 7**	**Plot 8**	**Plot 9**	**Plot 10**
Shanon- Weiners index (H)	3.04	2.30	2.84	2.71	3.28	2.69	3.14	2.41	2.80	2.96
Simpsons index (D)	0.06	0.15	0.07	0.10	0.04	0.12	0.04	0.13	0.09	0.06
Simpsons diversity index of diversity (1-D)	0.93	0.84	0.92	0.89	0.95	0.87	0.95	0.86	0.90	0.93
Simpsons reciprocal index (1/D)	16.65	6.45	13.47	9.42	24.24	7.97	20.62	7.33	10.39	14.45

Table - 5 Basal Area Of Collected Tree Members In The Study Area

Sl No.	Plant Species	Basal Area
1	*Adenanthera pavonia*	1.133
2	*Albizia saman*	13.88
3	*Alstonia scholaris*	26.86
4	*Areca catechu*	3.31
5	*Cocos nucifera*	5.8
6	*Cycas circinalis*	2.46
7	*Ficus religiosa*	22.68
8	*Gliricidia sepium*	7.53
9	*Leea indica*	1.45
10	*Macaranga peltata*	1.8
11	*Mangifera indica*	6.64
12	*Prosopis juliflora*	0.85
13	*Sterculia guttata*	5.8
14	*Swietenia mahagoni*	2.64
15	*Tectona grandis*	6.35
16	*Terminalia catappa*	2.37
17	*Ziziphus mauritiana*	0.9

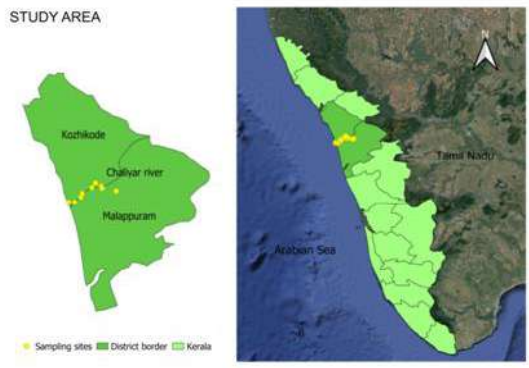

Figure - 1 Map of Study Area and sampling sites

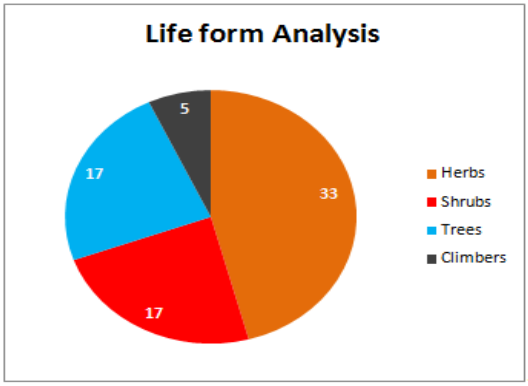

Figure - 2 Life form analysis in the study area

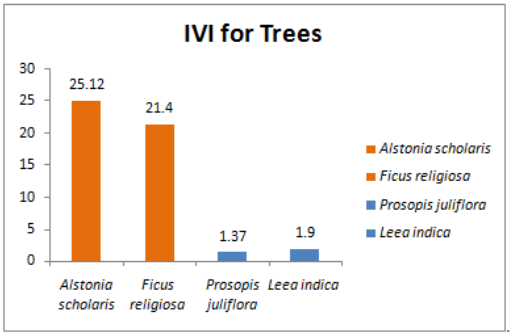

Figure - 3 Analysis of Importance value index of trees in the study area.

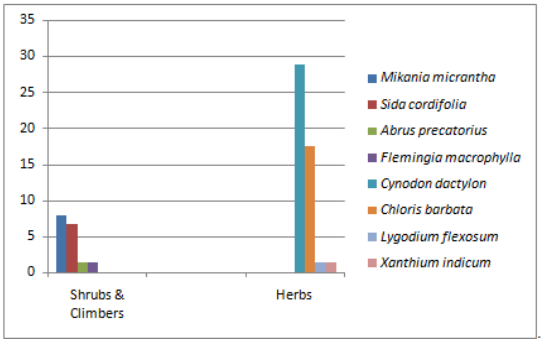

Figure - 4 Analysis of IVI for Herbs and Shrubs in the study area.

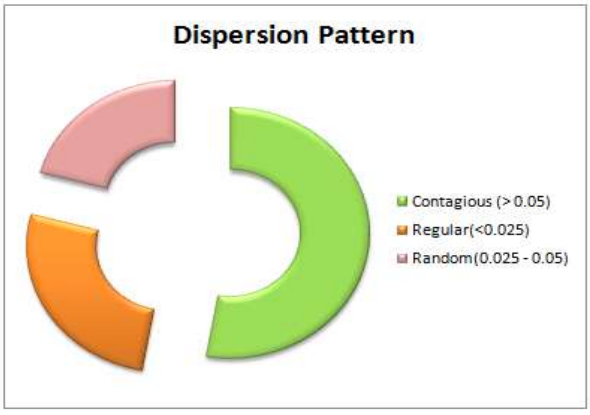

Figure - 5 Analysis of Dispersion pattern in the study area

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RESEARCH ARTICLE

Response of Dragon Fruit [*Hylocereus costaricensis* (web.) Britton and Rose] on Combine use of Chemical and Organic Nutrition Managements

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ABSTRACT

Dragon fruit has become a promising high value crop in India and responded well to organic production. The present investigation was planned to evaluate some integrated nutrient application approach in dragon fruit plant growth at Lucknow, Uttar Pradesh of India. There were 10 treatments (T_1 Control, T_2 100% RDF, T_3 100% vermicompost, T_4 100% FYM, T_5 75% RDF + 25% vermicompost, T_6 50% RDF + 50% vermicompost, T_7 25% RDF + 75% vermicompost, T_8 75% RDF +25% FYM, $T_9$50% RDF + 50% FYM, T_{10} 25% RDF + 75% FYM) with three replications laid out following Randomized Block Design. There were 4 plants per pole and poles were planted at 4 x 2 m spacing. The growth observations revealed that integrated use of recommended dose of fertilizers (RDF) and vermicompost followed by FYM had better option to reduce chemical nutrition hazards since effect of 75 % RDF + 25 % vermicompost was better on vegetative growth of the plants followed by 75 % RDF + 25 % FYM and 100 % RDF which increased vine length, areole distance, stem circumference and cladode length very well.

Keywords: Dragon fruit, Growth, INM, Organics

INTRODUCTION

Dragon fruit [*Hylocereus costaricensis* (Web.) Britton and Rose] is a perennial climbing cactus, belongs to the family Cactaceae (2n=22). It bears pink fleshed edible fruits and is one of the newly introduced exotic fruit crop in India. The origin of Dragon fruit is tropical and subtropical forest regions of Mexico and Central South America [1], however, has spread to Tropical and Subtropical America, Australia and Middle East Asian countries where it is now being cultivated commercially. The juicy flesh part of the fruit is delicious in taste when eaten as a fresh fruit. Fruit can be processed into products viz., juice, sherbets, jams, jellies, ice-cream, preserves, candies and pastries. The fresh fruit contains 82.5 - 83.0 per cent moisture, 0.16 - 0.23 per cent protein, 0.21 - 0.61 per cent fat and 0.7 - 0.9 per cent fiber along with 6.3 to 8.8 mg of calcium, 30.2 to 36.1 mg of phosphorous, 0.5 to 0.61 mg of iron and 8to 9 mg of Vitamin-C per 100 g edible part [2]. Dragon fruit also possess medicinal properties especially the red-fleshed varieties are rich in anti-oxidants. Regular consumption of fresh dragon fruit greatly helps to control asthma, cough, cholesterol, high blood pressure, stomach disorders, heart related problems, cancer, arthritis pain and good for diabetic patient.

It is a fast growing crop and needs judicial fertilizer management, but since it is a newly introduced in India [3, 4], fertilizer requirements needs to be searched for location specific, variety specific and critical stages of fertilizer application is also important. In India, some literature are found that it responses well to organic nutrient management that encourages the organic production of dragon fruit. But, the information regarding specific nutrient management schedule is very scanty. The organic manures not only provide nutrients to the plant but also improve the soil texture by binding effect to soil aggregates [5]. Use of vermicompost, FYM etc has been advocated in integrated nutrients management (INM) system in dragon fruits crops. Vermicompost help is reducing C: N ratio, increased humic acid content cation exchange capacity (CEC) and water soluble carbohydrates. It also contains biological active substance such as plant growth regulators. Farmyard manure and vermicompost can be responsible for affecting both quantitative as well as quantitative aspects of dragon fruit. Keeping these views a field experimental was conducted at Babasaheb Bhimrao Ambedkar University, Lucknow, Uttar Pradesh, India to formulate a fertilizer management practice as integrated nutrient management and to see its effect on growth of dragon fruit crop.

MATERIALS AND METHODS

The experiment was conducted at Department of Horticulture, Babasaheb Bhimrao Ambedkar University, Lucknow, U.P., India during 2020 and 2021. Lucknow is situated at 26^0 50′ N latitude, 80^0 5′ E longitude and the altitude of 123 meter above mean sea level (MSL). Lucknow shows subtropical climate with the average rainfall of about 110 cm and relative humidity 60-90% depending upon the weather and the climatic factor. It has a high temperature during hot summer and very chilling temperature during winter months. There were 10 treatments (T_1 Control, T_2 100% RDF, T_3 100% Vermicompost, T_4 100% FYM, T_5 75% RDF + 25% vermicompost, T_6 50% RDF + 50% vermicompost, T_7 25% RDF + 75% vermicompost, T_8 75% RDF +25% FYM, $T_9$50% RDF + 50% FYM, T_{10} 25% RDF + 75% FYM) with three replications laid out following Randomized Block Design (RBD). There were 4 plants per pole and poles were planted at 4 x 2 m spacing. The two years old plants were selected for the study and well rotted FYM 15 kg / pole and the recommended dose of fertilizers (RDF) 200 g N, 250 g P_2O_5 and 100 g K_2O / plant were applied as per the treatment schedule. Whole amount of P_2O_5 along with half of K_2O was applied at the time of planting and rest half of K_2O was applied after eight months of planting while nitrogenous fertilizer was applied in three splits doses 100 g at the time of planting, 50 g at three months after planting and 50 g at eight months after planting. The vegetative growth parameters were studied and observations were recorded as per the treatments. The significance of variance in the data obtained from the various vegetative growth characters was analyzed with F test as suggested by Sahu and Das [6] for randomized block design (RBD) at 5% level of significance.

RESULTS AND DISCUSSION

It is clearly evident from the Table 1 that there are significant differences among various nutritional treatments at 30, 60 and 90 days after treatment (DAT) and significant increase in plant height at 60 DAT from 30 DAT and at 90 DAT from 60 DAT. The maximum increase (18.56 and 29.50 cm) in plant height was recorded with T_5 treatment (75% RDF + 25% Vermicompost) at 60 and 90 days after treatment, respectively followed by 16.32 and 27.13 cm increase in T_8 (75% RDF +25% FYM) and 15.20 and 26.32 cm in T_2 (100% RDF). The minimum increase (12.75 and 24.08 cm at 60 and 90 DAT, respectively) was recorded in T_1 (Control plants). The data on increase in length of cladode of dragon fruit as influenced by integrated nutrient management (INM) treatments under study was presented in Table 1 which clearly showed a significant effect due to the various treatments. According to the statistical analysis, significantly maximum increase of length of cladode (8.35 and 14.56 cm, respectively at 60 and 90 DAT) was recorded in T_5 (75% RDF + 25% Vermicompost) followed by application of 75% RDF + 25% FYM (T_8) and T_2 (100% FYM). The effect of nutrition is to bring changes in the vegetative growth attributes of any crop. The increase length of cladode of dragon fruit was significantly influenced by the integrated nutrient management. Vermicompost is considered as a richer source of available plant nutrients and growth regulators and thus, have better effect on growth.

Application of 75% RDF + 25% Vermicompost (T_5) also increased distance between the areoles (1.90 and 2.05 mm) at 60 and 90 DAT, respectively followed by 1.77 and 1.89 mm distance in T_8 (75% RDF + 25% FYM) and 1.35 and 1.53 mm in T_2 (100% RDF), respectively. Control plants showed the minimum increase of distance between the areoles (0.40 and 0.56 mm increase at 60 and 90 DAT, respectively). Stem circumference is an important growth indicator and the present experiment found a significant increase in stem circumference due to integrated use of fertilizers. Maximum increase of stem circumference (1.40 and 1.50 cm, respectively at 60 and 90 DAT) was observed in T_5 (75% RDF + 25% Vermicompost) followed by application of 75% RDF + 25% FYM (1.13 and 1.20 cm, respectively) and very close to T_2 (100% RDF) which was *at par* with each other. The minimum stem circumference (0.23 and 0.24 cm) was recorded in control. Fig. 1 also showed a positive relation between increase in plant height and distance between areoles in dragon fruit plants. It was also evident from Fig. 2 and 3 that the plant height (plant length) and length of cladode followed a similar pattern of growth at 30, 60 and 90 DAT.

It was also cleared that the rate of increase in both cases was higher from 60 DAT to 90 DAT indicating a slow release of nutrients and their action after 60 days. The plant height, length cladode, and stem diameter increased with the advancement of growth period from 30, 60 and 90 days after treatment. The plant growth significantly increased due to integrated use organic and inorganic fertilizers. The maximum increase of plant height, length of cladode, distance between the areoles and stem diameter was noted with application of 75% RDF + 25% Vermicompost (T_5) followed by 75% RDF + 25% FYM and 100 % RDF in comparison to other treatments. Similar increase in vegetative growth by application of organic and inorganic fertilizers has also been reported by several researchers viz., Kumar *et al.* [7] in strawberry; Kumari *et al.* [8] in mango; Sharma *et al.* [9] in guava and Umar *et al*. [10] in strawberry but very limited in dragon fruits [11].

CONCLUSION

On the basis of present study it can be concluded that combined application of organic and inorganic fertilizers in the form of 75% Recommended Dose of Fertilizers + 25% vermicompost showed the maximum vegetative growth of dragon fruit grown at Lucknow condition.

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Table 1: Effect of chemical and organic nutrients on vegetative growth of dragon fruit.

	Plant height (cm)		Cladode length (cm)		Distance between areoles (mm)		Stem circumference (cm)	
Treatments	Increase in height (cm.) at 60 DAT	Increase in height (cm) at 90 DAT	Increase in Length of middle cladode at 60 DAT (cm)	Increase in Length of middle cladode at 90 DAT (cm)	Increase in distance betwee n the areoles (mm)at 60 DAT	Increase in distance between the areoles (mm) at 90 DAT	Increase in stem circumfer ence at 60 DAT (cm)	Increase in stem circumfere nce at 90 DAT (cm)
T_1 - Control	12.75	24.08	4.50	8.20	0.40	0.56	0.23	0.24
T_2 - RDF (100%)	15.20	26.32	6.30	12.95	1.35	1.53	0.70	0.76
T_3 – Vermicompost (100%)	14.13	25.56	5.67	11.30	0.70	0.94	0.50	0.54
T_4 - FYM (100%)	13.27	25.13	5.17	10.70	0.63	0.70	0.34	0.36
T_5 - (75%) RDF + (25%) Vermicompost	18.56	29.50	8.35	14.56	1.90	2.05	1.40	1.50
T_6 - (50%) RDF + (50%) Vermicompost	15.08	26.95	6.13	13.10	1.24	1.30	0.94	0.96
T_7 - (25%) RDF + (75%)	14.93	26.58	5.83	12.40	1.04	1.08	0.63	0.67

Vermicompost								
T_8 - (75%) RDF + (25%) FYM	16.32	27.13	6.75	13.55	1.77	1.89	1.13	1.20
T_9 - (50%) RDF + (50%) FYM	14.75	26.73	5.95	12.30	1.15	1.30	0.83	0.87
T_{10} - (25%) RDF + (75%) FYM	14.10	26.00	5.42	11.80	1.00	1.06	0.50	0.57
SEm (±)	0.850	0.761	0.374	0.708	0.268	0.249	0.052	0.098
CD (P=0.05)	2.544	2.279	1.119	2.121	0.802	0.745	0.156	0.294

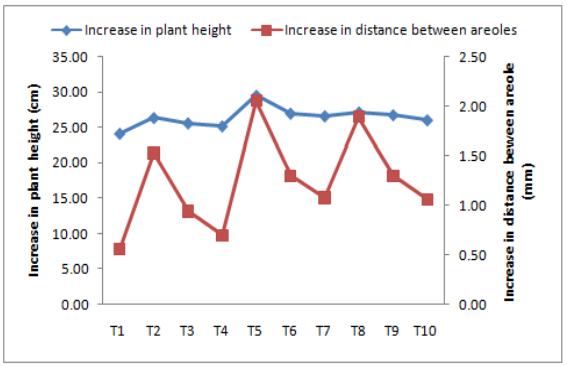

Fig. 1. Relation between increase in plant height and distance between areoles.

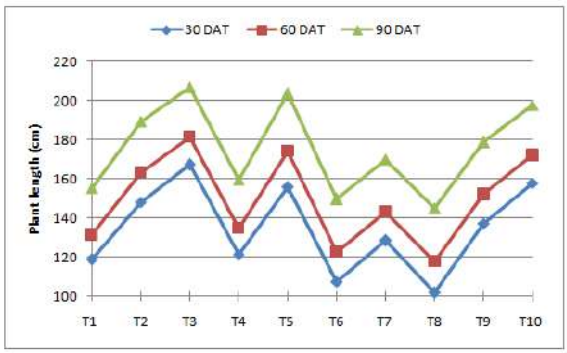

Fig.2. Plant length at 30, 60 and 90 days after treatment (DAT)

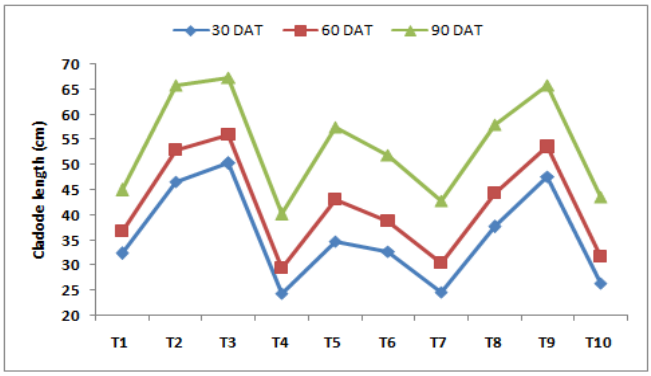

Fig. 3. Length of cladode at 30, 60 and 90 DAT

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RESEARCH ARTICLE

Optimization of NPK with Zinc Fertilizer on Yield and Quality Characters of Maize

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ABSTRACT

Maize is the third most important cereal next to rice and wheat, in the world as well as in India. Availabilty of aluminium, iron and manganese in acid soils of Cuddalore district is more due to higher dissolution and become toxic. The field experiment was conducted to study the effect of macro and micronutrient fertilizers on yield maximization of maize in sandy loam of soil of Vanniyarpalayam village belongs to Vadalapakkam series (*Typic rhodustalf)*, low in organic carbon, low in alkaline $KMnO_4$-N, low in Bray-P and medium in NH_4OAc-K. Field experiment was conducted with six treatments *viz.*, T_1 - 50% RDF, T_2 - 100% RDF,T_3 - 150% RDF, T_4 - 150% RDF+ $ZnSO_4$ @ 25 kg ha^{-1}, T_5 - 150% RDF+ $ZnSO_4$ @ 25 kg ha^{-1} + neem cake @ 200 kg ha^{-1}, T_6 - 150% RDF+ $ZnSO_4$ @ 25 kg ha^{-1} @ Azotobacter @ 2 kg ha^{-1}, T_7 - 150% RDF+ $ZnSO_4$ @ 25 kg ha^{-1} + Neem cake @ 200 kg ha^{-1} + Azotobacter @ 2 kg ha^{-1}. The experiment was carried out in Randomized Block Design (RBD) with four replications and tested with maize *var.* Dhanvi-166 as test crop. The results of the study clearly revealed that application of 50%, 100% and 150% consistently increased the yield and quality factors of maize. Among the treatments application of recommended dose of fertilizer @ 150%, zinc sulphate @ 25 kg ha^{-1}, neem cake @ 200 kg ha^{-1} along with azotobacter @ 2 kg ha^{-1} registered the maximum grain yield of 7620.48 kg ha^{-1} and same treatment registered maximum starch content and crude protein (72.6% and 12.0%). Regarding different levels (50%, 100%, 150%) of recommended dose of fertilizer, 150% recommended dose recorded a highest grain yield of 6487.84 kg ha^{-1} and lowest grain yield was noticed in 50% recommended dose of fertilizer *i.e.*, 5578.64 kg ha^{-1}. Grain yield of 6048.22 kg ha^{-1} was observed under 100% recommended dose of fertilizer.

Maize quality characters *viz.,* starch 52.1% and crude protein 8.5% was minimum under 50% recommended dose of fertilizer treatment. It could be concluded that application of balanced and integrated use of nutrients viz., 150% recommended do se of fertilizer, zinc sulphate @ 25 kg ha^{-1}, neem cake @ 200 kg ha^{-1} and azotobacter @ 2 kg ha^{-1} significantly improved the yield and quality characters of maize crop in Cuddalore district soils.

Keywords: 200 kg ha^{-1} + Azotobacter, fertilizer, NH_4OAc-K, increased the yield

INTRODUCTION

Maize (*Zea mays* L.) is one of the most important cereal crops in the world agricultural economy, both as food for human beings and feed for animal. Because of immense yield potential, it is regarded as "miracle crop" and also "Queen of cereals". It is a versatile crop and can be grown in diverse environmental conditions and has multiple uses. Among the districts of Tamil Nadu, Cuddalore has a larger area of 0.21 lakh hectares under maize with average production of 231 lakh tonnes. In spite of the increased yield declining soil fertility and insufficient use of macro and micronutrient fertilizers resulting in severe soil nutrient depletion. Among the plant nutrients, macronutrients such as nitrogen, phosphorus and potassium play a crucial role in deciding the maize growth and yield. Maize has high yield potential and responds greatly to applied fertilizers. Deficiency of micronutrients may emerge when the supply of micronutrients to the soil is less compared to removal through crop harvest which in turn limits crop productivity (Shukla *et al.,* 2009). Zinc deficiency is usually corrected by the application of zinc sulfate. Response to applied zinc for better growth and yield of several important field crops has been reported from many countries (Shivay *et al.,* 2008). The concept of balanced fertilization paves the way for optimum plant nutrient supply to exploit the full yield potential of maize and takes care of soil nutrient deficiency. The present study is one such attempt to evolve fertilizer optima for hybrid maize (DHANVI 166) and to find out the response of bio fertilizer like azotobacter and manure like neem seed cake in maize crop. Bio fertilizers are microbial inoculants with specific species of microorganisms which are used for stimulating microbial process in soil for mobilizing soil or atmospheric nutrient to plants. Meena *et al.* (2011) reported that application of azotobacter recorded significantly higher yield in maize. Rajesh *et al.* (2018) also reported that application of 100% NPK and Azotobacter increases the grain yield of maize over control. Neem contains substantial nutrients, thus they can serve as organic manure for sustained crop productivity in any soil. Daudu *et al.* (2007) observed that the combined application of neem cake and inorganic fertilizers increased the yield and quality of maize. Verma *et al.* (2018) revealed that application of Azotobacter with mustard oil cake followed by neem oil cake alone and neem oil cake with farm yard manure recorded highest yield in wheat.

MATERIALS AND METHODS

An experiment was conducted at Vanniyarpalayam village of Kurinjipadi taluk, cuddalore district, Tamil Nadu during 2018 in maize hybrid DHANVI- 166. The experiment consists of seven treatments *viz.* T_1- 50% RDF, T_2- 100% RDF, T_3- 150% RDF, T_4- 150% RDF+ $ZnSO_4$ @ 25 kg ha^{-1}, T_5- 150% RDF+ $ZnSO_4$ @ 25 kg ha^{-1} + Neem cake @ 200 kg ha^{-1}, T_6- 150% RDF+ $ZnSO_4$ @ 25 kg ha^{-1} + Azotobacter @ 2 kg ha^{-1}, T_7- 150% RDF+ $ZnSO_4$ @ 25 kg ha^{-1} + Neem cake @ 200 kg ha^{-1} + Azotobacter @ 2 kg ha^{-1} was laid in Randomized Block Design and replicated four times.

RESULT AND DISCUSSION

From the data, it is found that application of different levels of recommended dose of fertilizer (50%, 100% and 150%), neem cake, and azotobacter with micronutrient ($ZnSO_4$) caused a significant effect on grain and stover yield of maize crop. Among the treatments, application of recommended dose of fertilizer @ 150%, Zinc Sulphate @ 25 kg ha^{-1}, neem cake @ 200 kg ha^{-1} along with Azotobacter @ 2 kg ha^{-1} registered maximum grain and stover yield of 7620.48 and 8951.91kg ha^{-1} respectively which is on par with T_5. The lowest grain (5578.64 kg ha^{-1}) and stover (6526.48

kg ha^{-1}) yield was recorded with 50% RDF. This can be explained by the fact that plant is dependent mainly on vegetative and vigorous growth. Higher uptake of nutrients and efficient assimilation of applied nutrient during vegetative growth is attributed with higher growth and yield. This might be due to application of recommended dose of fertilizer with zinc sulphate during the vegetative stage. These results are conformity with the findings of Navyashree *et al*. (2015) and Amanullah *et al.* (2016). Being a part of enzymatic reactions, Zinc sulphate is required for plant metabolic activities such as respiration, meristamatic development, chlorophyll formation, photosynthesis, and energy system and protein synthesis in maize crop, which could increase the yield. They are in line with the findings of Kakar *et al.* (2006) and Ashok *et al.* (2008). Neem seed cake when applied to the soil not only improves the soil with addition organic matter but also acts as nitrification inhibitor which lowers nitrogen loss and improves the nitrogen use efficiency (Shivakumar *et al*., 2011 and Verma *et al*., 2018).

Different treatments recorded a significant effect on crude protein content, which ranged from 8.5 to 12.0 per cent with. Maximum crude protein (12.0%) and starch (72.6%) content was obtained from the combined application of 150% recommended dose of fertilizer, zinc sulphate @ 25 kg ha^{-1} and neem seed cake @ 200kg ha^{-1} along with Azotobacter @ 2 kg ha^{-1} and which is at par with T_5. Lowest starch (52.1%) and protein (8.5%) content was recorded with 50% recommended dose of fertilizers application. The better growth, development and dry matter accumulation with proper supply of nutrient to plant and increased availability of other nutrients with respective source of nutrient application might be reason for increase in crude protein and starch content in maize. Similar findings are recorded by Sobhana *et al.* (2013) and Jeet *et al*. (2014). Crude protein content in maize increased significantly with application of phosphorus (Ghodpage *et al.,* 2008 and Singh *et al.,* 2010). Plants deficient in potassium will not produce proteins despite an abundance of available nitrogen. Potassium activates the enzyme nitrate reductase which catalyzes formation of protein. These results were in accordance of Ujwala Ranade, (2011) and Meena *et al.* (2018). High uptake of nitrogen by plant leads to protein yield of maize by azotobacter combination because azotobacter increases the nitrogen content in soil. Almost similar findings were also reported by Wagh (2002).

CONCLUSION

It could be concluded that application of balanced and integrated use of nutrients viz., 150% recommended dose of fertilizer, Zinc sulphate @ 25 kg ha^{-1}, neem cake @ 200 kg ha^{-1} and azotobacter @ 2 kg ha^{-1} significantly improved the crop productivity of maize.

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Table1: Grain and stover yield (kg ha^{-1})

Treatments	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})
T_1- 50% RDF	5578.64	6526.48
T_2- 100% RDF	6048.22	6986.00
T_3- 150% RDF	6487.84	7464.63
T_4- 150% RDF+ $ZnSO_4$ @ 25 kg ha^{-1}	6809.42	7902.74
T_5- 150% RDF+ $ZnSO_4$ @ 25 kg ha^{-1} + Neem cake @ 200 kg ha^{-1}	7442.15	8651.66
T_6- 150% RDF+ $ZnSO_4$ @ 25 kg ha^{-1} + Azotobacter @ 2 kg ha^{-1}	7018.44	8192.35
T_7- 150% RDF+ $ZnSO_4$ @ 25 kg ha^{-1} + Neem cake @ 200 kg ha^{-1} + Azotobacter @ 2 kg ha^{-1}	7620.48	8951.91
SEd	134.34	178.38
CD (p=0.05)	295.55	392.45

Table 2. Crude protein and starch content (%)

Treatments	Crude protein (%)	Starch content (%)
T_1- 50% RDF	8.5	52.1
T_2- 100% RDF	9.2	56.2
T_3- 150% RDF	10.0	60.1
T_4- 150% RDF+ $ZnSO_4$ @ 25 kg ha^{-1}	10.8	67.7
T_5- 150% RDF+ $ZnSO_4$ @ 25 kg ha^{-1} + Neem cake @ 200 kg ha^{-1}	11.8	72.4
T_6- 150% RDF+ $ZnSO_4$ @ 25 kg ha^{-1} + Azotobacter @ 2 kg ha^{-1}	11.1	68.0
T_7- 150% RDF+ $ZnSO_4$ @ 25 kg ha^{-1} + Neem cake @ 200 kg ha^{-1} + Azotobacter @ 2 kg ha^{-1}	12.0	72.6
SEd	12.5	1.63
CD (p=0.05)	0.6	3.6

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RESEARCH ARTICLE

A Turing Test for a Cognitive Algorithmic Model of a Creative Process in Music

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ABSTRACT

A Turing test was done to get the evaluation of a set of algorithm-generated musical melodic patterns versus a set of human musician's musical patterns. The Turing test is a reference for evaluating the effectiveness of a man-made system to simulate human activity. A mathematical model and algorithmic results done for the process of performance of Kalpana swaras, a creative improvisation found in the South Indian Classical musical genre was taken for this experimental study. A background of this process and genre of music with a brief summary of this algorithm has been presented. Twenty listeners rated a set of 10 patterns of the computer model and 10 human musician composed patterns, on a 5-point scale. The average score for the human-composed patterns was 4.065 against 3.750 for the model. At a 5% level of significance, the null hypothesis that the 'computer-generated and the human musician-generated patterns are not different', was rejected based on the z value. The human patterns scored higher. Since the human musician's music was a selection from highly accomplished musicians, and the model's output scored just marginally less than those of the humans, the conclusion was that the model's creativity could be considered as equal to a junior human musician. Improvements of the algorithm are discussed in this paper, with pointers to including more aspects of the human process. In conclusion, further studies of this process and modeling could improve the algorithm to equal a human musician's creativity, besides giving insights into the cognitive, learning, and aesthetic aspects of creative human activities.

Keywords: Cognitive modeling, Cognitive test, Creativity, AI, Algorithmic Music, Indian Classical Music, Musical Improvisation, Turing test

INTRODUCTION

The domain of intersection of art and math is very unique. In the genre of South Indian Classical music, certain improvisational forms of composition and performance are highly mathematical and lend themselves to mathematical simulation. This model deals with one such process, known by the name Kalpana swara. According to an encyclopedia on creativity, creativity in music refers to both the divergent and convergent thought processes[1]. This phenomenon of Kalpana swara performance, in addition to divergent, apparently random melodic progressions, literally paints the audio canvas with mathematical patterns, with an intuitive convergence and marked climax in the progression of melodic sequence, and such aspects of creativity. The Turing Test is widely regarded as a method to validate any intelligent cognition-based mental activity, despite the limitations of modeling very complex and multiple functions [2]. Cognitive Tests are assessments of the cognitive capabilities of humans and other animals, and in this study, we have extended it to test the cognitive model underlying the software algorithm generating the melodic patterns. The software model under evaluation, by being a mechanism to build in the cognitive processes behind the human activity of this improvisational artistic expression, is thereby a suitable case for a Turing test. In this study, a set of melodic patterns generated (composed) by the computer model and another set of melodic patterns generated (composed) by performing musicians, are evaluated by listeners, as a blind test. The two sets of scores are statistically analyzed for the model to pass the statistical Turing test. In an effective implementation of the cognitive model, the computer program would have in effect imbibed the 'creative thinking' or cognitive basis for generating these melodic patterns under the particular melodic framework (technically known as *Raga*), and rhythmic cycle (technically known as *Tala*). A full description of this model as a Markov process with sample outputs has been published as a technical paper[3]. A study of this model and its effectiveness can help to get insights into the learning and related aspects of creative human activities that involve math as well as art. It will also help to fine-tune this model to improve the quality of the simulation.

AI and Music

AI has been considered to have two important branches or aspects: A scientific part (Cognitive Science) that seeks to develop theories and explain intelligent human phenomena, and an engineering part which involves the design and development of machines and algorithms that can do intelligent processing or activities, in a way that mimics the human intelligence. To cite Curtis Roads, one of the early researchers and composers in the field of music and computers, 'Music projects have engaged both the scientific and applied aspects. The precise boundaries of AI are elusive, since they are related to what people feel is "intelligent behavior." In the early 1950s, adding thousands of numbers per second was considered the work of "giant brains." Today's expectations for intelligent behavior are much higher' [4]. The genre that this paper addresses is unique as there are very few instances of such mathematically evolved creative processes in music across the globe. The improvisational aspects of Indian Classical Music have always challenged intelligence and the level of sound patterns that are literally a different dimension of geometric and mathematical patterns are very commonly found in very intricate and complex forms in these musical performances. The uniqueness of the 'intelligent' part of this music is that much of these improvisations are performed spontaneously, and even reproduced spontaneously by artistes and musicians highly accomplished in this musical art form. These improvisational aspects have a very ancient origin, though some scholars feel that it could have changed in format to some extent over several centuries, with the same basic aspects. For example, the concert format and duration itself over the last few centuries have changed and evolved into different forms, with a very significant reduction in number of hours for a performance from those that could easily go over 4 hours to those which are considered full concerts but are performed for less than one hour duration.

Algorithmic Studies in Music

Algorithmic music has been a concept from ancient times, even before the advent of computers. One of the earliest instances of this is the system devised by Mozart for composing in which dice are used to select randomly from several possible arrangements of each bar for a minute, designed in the late 18th century [5]. As a computer scientist, Turing was a pioneer, creating the first computer-generated musical notes in 1948–1949 [6]. This research has

advanced more in the last few decades. Since audio technology and techniques have also advanced greatly this has progressed to such an extent that there have been concerts and performances of machine-generated music also in recent times. These developments, combined with advances in editing and sound engineering technology has made the music field and more specifically the commercial music industry emphasize skills and knowledge in these supporting techniques and areas much more than the skills, mastery and knowledge of playing an instrument or singing, as the key requirements and indications for a successful musician.

Some of the earlier algorithms have used various mathematical models, and some of them have also used Markov elements. Povel has described a melody generator and has also evaluated the output from the algorithmic approach, though not in a comparative way [7]. Leach & Fitch analyzed the connections between nature, music, and algorithmic composition [8].We can intuitively observe and explain by the sequence of notes also, that even many of the simple melodies observed in nature like the two or three-note call of a bird have an inherent algorithmic nature. Several interesting generative theories for algorithms have been proposed by some scholars. [9][10]. Universally, in many systems of music, one of the simplest structures for a continual flow of melody uses a first-order Markov progression, as observed by Prechtl [11]. Studies in algorithmic musical structures, that have significant elements of Markov and stochastic models, have been done by Krishnamurthi [3] in South Indian music, Serra [12], Farbood & Schoner [13], Verbeurgt [14], Eigenfeldt & Pasquier [15], Collins *et al*. [16], and Shibata [17]. Some significant studies in a genre that is not typically Western Music based are also by Steedman [18], Biles [19] and Hirata & Aoyogi [20] in Jazz, and South Indian music by Prusinkiewicz *et al*. [21]. V. S. Viraraghavan *et al*. [22] also studied the South Indian Classical system of music, but from the viewpoint of representational modeling, rather than generative modeling.

MATERIALS AND METHODS

About the genre

Raga and tala are the two most important concepts in the Indian Classical genre. A *raga* can be defined as a framework or a sub-set based on a scale (as in the Western musical system, e.g., a C-Major scale) which characterizes a family of melodic patterns. *Tala* is a system of rhythm cycles, consists of repetitive counts of either 3,4,5,6,7, 8, or various other such integral cycle lengths. The domain of modeling pertains to the specific musical structures, that are performed in the system of classical music that is practiced in the South Indian Classical style. This South Indian style is also known as 'Carnatic' music. In this process that has been implemented as a software model, the melodic sequences are generated as a set of notes, from the set CM = {S, R, G, M, P, D, N} which roughly correspond to the notes in western music of the set WM = {C, D, E, F, G, A, B}. In addition, higher and lower octaves of these notes also can be used. This is a rough equivalence and more detailed explanations can be had from the book series on South Indian Music by Sambamoorthy [23]. Since here the model is about the mathematical structures behind the notes, it would suffice to note that the sequences generated by a system, or a human performer is output as a sequence of notes, from the set CM, with some additional elements like a symbol for a time extension of a note denoted by a comma, and an octave qualifier. This is conventionally represented in the common music notation of the genre by a dot on the top or bottom of the letter for the note, to denote the higher or lower octaves. The simulation run in the earlier study gives an output of the generated sequences which is used by a performer in this study like sheet music, to create an audio track for evaluation. Thus, the audio track used for evaluation of the melodic appeal by a group of listeners contains 10 sequences of human performer's composed sequences, and 10 of those which were generated by the software algorithm, as the system-composed melodic sequences.

The Cognitive Model

The process of improvisation in musical performance in Indian Classical music has a very unique mathematical structure, not found in other classical systems of music globally. The earliest significant paper on the mathematical modeling of this creative process defines the process of performance of Kalpana swaras, a specialized form of spontaneous improvisation in South Indian Classical Music which is also known as Carnatic music, as the process of 'composing and singing (or performing on an instrument) spontaneously a string of swaras with melodic continuity,

conforming to a Raga, and joining it up, without loss of melodic continuity to a pre-set tune at a fixed point in the time-cycle *(tala)'* [3]. A swara in Indian music can be roughly defined as a musical note, and here they are denoted by the members of set CM, mentioned earlier. [22]. The output is given in the form of the sequence of the notes. A very basic overview of the model is that it has a sequence of notes as the natural flow of the melody which is defined by its ascending and descending set of notes. The melody is built in such a way that for the next note based on the current note, one of the following six choices are randomly selected, noting the constraints mentioned.

1.next higher note in the scale of melodic progression
2.next lower note in the scale of melodic progression
3.second higher note, with the constraint that the next choice is one note lower
4.second lower note, with the constraint that the next choice is one note higher
5.repetition of the same note
6.extension of the same note for another time period

There are additional constraints for the convenience of modeling, and also from aesthetics consideration, limiting the total range of notes (over the higher and lower octaves from the one that the base melody is performed) that is normally used for the sequence generation, to reduce the probabilities for a sequence that keeps ascending. In addition, the repetition of more than once is not allowed, though in human improvisation, by a skilled and sensitive musician, there could be cases of even more than three repetitions without sounding banal or trivial. For simplicity of modeling, this algorithm had introduced these constraints also. There is another feature that the note has to converge on a fixed note after the development of a certain number of notes in the sequence (based on the rhythm cycle of tata), without violating these melodic generation rules. This aspect is handled intuitively by the human performers, but in this model, the problem has been solved by a reverse generation of the sequence. This has been made possible since the model did not attempt to generate and perform the musical sequences in real-time, but rather took the approach of generation and output of the sequence of notes. Note that in the table of generated sequences, the last, 16th note is always 'N'. In these sequences taken for study, all the last three notes have turned out to be constant. However, in a lower probability of occurrence, we could get sequences that were not necessarily fixed in the last three notes, but still sounding melodic and creative. These are usually employed by a highly skills creative human musician and were not addressed in the model. The algorithm used a mapping of integers to the sequence of notes so that the seven notes of each octave were mapped to a sequence of 7 monotone ascending integers. The initial run of the software algorithm generated 200 sequences of the 16-note patterns. With a changed random number seed, the output was a completely new set of melodic patterns. By this psychological cognitive experimental study and hypothesis testing, we can get better insights and directions for the improvement of the model and pointers to extend this approach to other creative processes.

The details about the set of allowed notes in the *raga*, as explained in the last two paragraphs are simplified models, which would be valid only for a subset of melodies which are symmetric in ascent and descent. However, the model works fairly well for such *ragas*, which are most commonly used. In addition, the model is a basic model and does not attempt to model the creativity of a top highly accomplished musician in this improvisational form, but more attempts to mathematically model the basic features of the creativity in the melodic sequences. Further, in terms of the rhythm cycle, this implementation models only the cycle of 8 beats, though the same principles will hold for the improvisational melodies in any other rhythmic cycle, like 5 counts or 6 counts. Since the beat cycle of eight counts is the most commonly used one in this genre, (with 3 or 6 counts being the next most common) it is the right approach for the initial models and the simulation runs to have addressed this.

The Cognitive Test

The cognitive testing was done with a set of 10 melodic sequences composed by the system, and another set of 10 melodic patterns composed by humans, given in Table 1. The instrument for data collection was an audio file of the melodic sequences shared with the subjects on digital media, with a set of instructions for scoring. The listeners evaluated these on a 5-point scale and sent the ratings for these twenty sequences. The rating score of every

evaluator (listener) for the computer-composed melodic patterns and also the human-composed melodic patterns were thus obtained. The evaluators are denoted by A to T in Tables 2 and 3. The instructions given required them to give one overall rating (between 1 and 5) for each melodic pattern (sequence of 16 notes) based on how the listener felt on hearing the pattern, in terms of aesthetic appeal, creativity, melodic and rhythmic appeal. Each sequence is a set of notes, represented by one of these letters. There are also some special notes. (A comma is an extension of the previous note. A qualifier dot on top or below a note, indicates a higher/lower octave. C/H in the last column denotes computer/human.

RESULTS

Table 2 and Table 3 - Summary of raw scores
The tables below give the ratings given by the 20 evaluators, denoted by A to T
Statistical Analysis and Hypothesis Testing

No of system-composed pattern scores	(C) : 200
No of human-composed pattern scores	(H): 200
Mean score of	(C) : 3.750
Mean score of	(H) : 4.065
Standard deviation of	(C) : 0.9758
Standard deviation of	(H) : 0.8801
Range of scores for	(C) : 3
Maximum/minimum score for	(C) : 5 and 2
Range of score for	(H) : 4
Maximum/ minimum score for	(H) : 5 and 1

Hypothesis: (Null Hypothesis) There is no difference in the rating scores between the computer-composed patterns and human composed patterns.
Since the group size is large, the z-test is used to verify the hypothesis. The difference in means is found out and the z value is calculated by

$Z = (X_1 - X_2) / \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}} = 3.39$

At 5% level of significance for the two-tailed test
R: $|z| >= 1.96$
The observed value of z is 3.39, which falls in the rejection region and thus we reject H_0 at 5 % level.

DISCUSSION

The average rating of the human-generated patterns was found to be 4.065 and those of the computer model 3.750, on a 5-point scale. At a 5% level of significance, the Null hypothesis has been rejected and the human patterns were found to be higher in rating. Since the music generated by the humans were from typically top-rated highly accomplished musicians, and the rating of the system is close to that of the humans, we infer that the system's performance was only marginally less appealing than a top-rated musician. (3.75 vs. 4.06, on a maximum score of 5). The computer-composed melodic patterns and the computer-composed patterns have not passed the Turing Test with a 5% level of significance. However, looking at the ratings given to the melodic patterns and aspects like the number of high ratings, the difference was marginal and there were several computer-generated patterns also which have been rated very high by listeners. (Top score of 5 for 27% of the computers versus 37.5% of the human's). Also noteworthy is the observation from the other statistical table of frequency percentage of the ratings, (Table 4) we find that the human-composed patterns have received a low score of 1 in two cases out of 200, whereas in the computer-composed, none of them have got a rating below 2. Also, noting that these human-generated melodic patterns were from highly accomplished musicians, we may infer that the computer model performs roughly equal to a second-

grade or a less experienced artiste. This points to a possibility of further refining the algorithm through the study of more samples of human performances, and better modeling, fine-tuning the algorithm, to eventually arrive at a model to successfully 'pass' a stringent Turing test. As a pointer to improving the algorithm, we can observe that although there is a second-order element in this Markov model, a brief discussion with skilled musicians revealed that a musician could even operate at even higher orders, to increase the aesthetic variety, in this improvisation process. A closer examination of the human-composed sequences revealed that there are possibilities with some constraints for skipping 2, 3, or even 4 notes also as in the patterns of the human musicians, for sequence no 15, 16, 17, and 19, with perhaps certain additional constraints that could make the order of the Markov higher than 2.

Thus, the design of the Markov algorithm could be possibly improved, by a deeper analysis. In terms of further analysis of the results, it may be noted that there could be *Ragas*, or scale-based frameworks for improvisation, which could be structurally very complex and highly difficult for even an accomplished human performer, which could be modeled and implemented through this algorithmic approach, with the result that the computer-based model may score higher than the human performers in such aspects. Though at this point the possibility seems very remote, coming from a psychological perception for a typical listener of this genre of music, and also due to the complexities in modeling finer aspects of the raga frameworks in this genre, technically referred to by various qualifiers like *vakra raga*, and *bashanga* raga, (which indicate a non-linear progression of the sequence of notes, and usage of notes of a foreign scale in a *raga* of a primary scale) it is still a direction for future research and could open up and push forward frontiers of these systems of music in various ways, also help to mathematically model other domains of cognitive processes and human activities. It would be interesting to note that in this specific type of musical creativity addressed by the genre of music and the model, the traditional Indian name for the improvisational creative music is *manodharma sangeet*, literally meaning 'music arising from the natural flow of the mind'. *Manas* means mind, *dharma* stands for the inherent nature of any entity, and *sangeet* means music, in Sanskrit. Thus, these ancient cultures were very much aware of the role of the mind in music and the nature of these creative patterns as inherently arising from the mind.

CONCLUSIONS

The results could be interpreted that the model works well but with a marginally lower level of average aesthetic quality. There is a scope to improve the model and algorithm to sound aesthetically closer to that of a human musician. Due to its dynamic, improvisational nature, the genre of Indian Classical Music, and more specifically the South Indian variant of the system, is a very significant example of creativity. This creativity is of the nature that would be known as 'on-the-spot', and not of the pen-and-paper type where you have time to reflect on the output and refine it more and more in iterations, with feedback either from one's perceptive evaluation or from other's feedback.By studying these creative structures and how the mind creates them, there are possibilities to get more insights into the working of the mind towards helping and enabling more creativity in various fields, not confined to music only. The role of random progression within a boundary of goals, in the form of a target picture or a solution state, in visual arts and trial-and-error-based problem-solving methods in mathematical solutions has been observed. This evaluation study for the cognitive model of the musical generative process could serve as one more input to this field, in the wider understanding of mental models in psychology. Studies indicate that influence of music on language learning mechanisms could have other social benefits than just benefitting the music domain [24]. A recent study by Bačlija Sušić talks about the possible impact of music on children's speech development [25]. Thus, we present this study to add to the body of knowledge in modeling cognitive processes that could impact multiple fields.

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Table 1- Melodic Sequences

1	D	,	N	D	M	G	D	M	G	R	,	G	M	P	D	N	H
2	N	.S	N	D	N	D	P	D	P	M	P	G	M	P	D	N	H
3	S	R	,	G	R	G	,	M	P	P	D	P	M	P	D	N	C
4	.G	.R	,	.S	N	D	,	P	M	G	,	G	M	P	D	N	H
5	-	M	,	G	P	M	G	,	R	G	,	M	,	P	D	N	C
6	N	,	D	N	D	N	N	D	M	P	D	D	N	P	D	N	C
7	R	G	G	,	M	P	P	M	G	R	G	M	,	P	D	N	C
8	S	R	G	M	P	M	G	R	S	R	,	G	M	P	D	N	H
9	S	R	G	S	R	N.	S	R	R	G	M	,	P	P	D	N	C
10	.S	N	.S	D	N	.S	P	D	N	.S	M	,	,	P	D	N	H
11	N.	,	S	R	G	M	P	G	M	,	P	G	M	P	D	N	C
12	N.	R	N.	R	G	M	D	M	G	R	,	G	M	P	D	N	H
13	S	N.	S	S	N	S	S	R	M	G	R	G	M	P	D	N	C
14	R	G	,	M	P	D	P	M	G	M	D	P	M	P	D	N	C
15	G	N	D	,	,	P	M	G	,	,	R	G	M	P	D	N	H
16	G	D	P	D	M	P	G	M	P	G	M	G	M	P	D	N	H
17	.G	.R	,	.S	N	D	.R	.S	,	N	D	P	M	P	D	N	H
18	R	G	S	R	G	R	,	G	M	P	G	,	M	P	D	N	C
19	D.	G	R	,	P	M	G	N	D	,	P	G	M	P	D	N	H
20	N	S	D	N	N	D	P	D	D	N	P	D	D	P	D	N	C

Table 2: Human composed pattern scores

4	3	5	4	5	5	4	5	5	5
5	3	4	4	5	5	5	4	4	4
5	5	5	5	5	5	5	5	5	3
4	3	4	2	3	3	3	4	5	4
3	4	3	4	4	5	4	4	4	5
3	4	4	4	5	5	4	5	5	4
2	3	4	4	5	4	3	4	4	4
4	4	3	3	3	5	5	5	3	4
4	4	4	4	4	5	4	5	4	5
5	3	4	4	5	4	5	4	4	4
5	5	5	5	5	5	5	5	5	5
3	1	5	2	3	5	3	4	4	5
5	4	4	2	5	5	4	5	4	3
4	3	3	1	4	5	3	3	4	5

4	5	3	2	2	3	4	5	2	4
5	5	3	3	4	5	3	4	5	4
4	5	4	4	3	5	4	5	3	3
4	4	3	4	3	4	3	5	4	4
5	4	3	3	4	5	4	5	4	5
4	4	4	4	5	4	4	5	4	4

Table 3: Computer-composed pattern scores

5	3	5	4	3	4	2	2	5	2	A
2	5	2	5	3	4	2	3	3	3	B
5	5	5	5	5	4	3	4	3	4	C
4	3	3	3	4	5	3	2	4	3	D
5	4	5	5	5	5	5	5	4	5	E
5	4	3	3	5	5	4	4	3	5	F
2	4	3	2	4	3	2	3	3	5	G
3	4	4	4	4	4	3	4	4	5	H
3	4	4	4	5	4	4	4	5	4	I
5	3	5	3	2	3	2	3	3	3	J
5	5	4	5	5	5	4	5	5	5	K
4	3	4	3	2	3	3	3	3	3	L
3	3	5	2	4	3	3	4	4	5	M
2	4	5	4	4	3	2	4	5	3	N
4	4	4	2	3	5	3	3	3	4	O
4	2	4	3	5	5	3	3	4	5	P
3	4	2	3	5	4	4	4	2	2	Q
5	5	3	4	3	5	4	3	3	3	R
3	5	2	3	3	5	4	3	5	4	S
4	4	4	4	5	4	4	5	4	4	T

Table 4 – Frequency Comparison of Ratings

Score	Frequency (Human)	% (Human)	Frequency (Computer)	% (Computer)
1	2	1%	0	0%
2	7	3.5%	22	11%
3	38	19%	60	30%
4	82	41%	64	64%
5	71	35.5%	54	27%

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RESEARCH ARTICLE

Effect of Silicon and Phosphorus on Yield and Quality of Wheat (*Triticum aestivum* L.) in Loamy Sand Soils of North Gujarat

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ABSTRACT

To seek out the effect of silicon and phosphorus on yield and protein content in wheat grain in loamy sand soils of North Gujarat, a field experiment was conducted at the Agronomy Instructional farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during Rabi season of 2020-2021. Experimental soil was loamy sand in texture with pH 7.01 and electrical conductivity 0.19 dSm^{-1}. The soil was low in organic carbon (0.39%) and medium in available phosphorus (38.10 kg ha^{-1}) and available potassium (191.25 kg ha^{-1}). Available silicon in soils was 60.75 mg kg^{-1}. The experiment consisted of 4 levels of phosphorus (0, 30, 60 and 90 kg P_2O_5 ha^{-1}) and 4 levels of silicon (0, 100, 200 and 300 kg Si ha^{-1}). Totally sixteen treatment combinations were laid come in randomized block design with factorial concept and replicated thrice. All the plots received a homogenous recommended dose of nitrogen @ 120 kg ha^{-1}. The results of the experiment revealed that application of 60 kg P_2O_5 ha^{-1} recorded the best grain yield (3808 kg ha^{-1}), straw yield (5729 kg ha^{-1}) and protein content (10.69%), while among the silicon levels application of 100 kg Si ha^{-1} recorded the very best grain yield (3619 kg ha^{-1}) and straw yield (5584 kg ha^{-1}). Within the case of protein content, the best (10.70%) was observed with 200 kg Si ha^{-1}. With respect of combination treatments, maximum grain (4304 kg ha^{-1}) and straw yields (6201 kg ha^{-1}) was found with 60 kg P_2O_5 ha^{-1} together with Si level at 100 kg ha^{-1}. All the interaction effects of protein were found to be non-significant. The results of experiment concluded that application of 60 kg P_2O_5 ha^{-1} along with 100 kg Si ha^{-1} recorded highest grain and straw yields in loamy sand under North Gujarat Agro-climatic conditions.

Keywords: Agriculture, silicon and phosphorus, organic carbon, yields.

INTRODUCTION

Wheat (*Triticum aetivum* .L) is a vital staple food of the globe which belongs to the genus *Triticum*. In 2020, production of wheat has reached 760 million tonnes making second most produced cereal after maize. They are rich in carbohydrates and protein of 13%, making it an leading source for vegetable protein in food source but relatively low in protein quality for supplying essential aminoacids. Phosphorus is important macronutrient which is important for plant growth. Plants absorb phosphorus as orthophosphate (H_2PO_4 and HPO_4) forms (Hinsinger, 2001). It's the most important plant growth-limiting nutrient despite its abundance in soils in both inorganic and organic forms (Gyaneshwar *et al*., 1999). Phosphorus plays a vital role in physiological process *viz.* photosynthesis, storage of energy and its transfer, respiration and cell enlargement and cell biological process, *etc*. Essential energy rich phosphate compounds which derive various biochemical reactions within the plant include nucleotide (ATP) and nucleotide (ADP). The structure of biochemical components of living things, *viz.* super molecule (DNA and RNA), nucleotides, phospholipids and phosphoproteins don't seem to be possible without phosphorus. Next to nitrogen, phosphorus is that the most sinificant nutrient needed by a wheat crop. Phosphorus is required from seedling to maturity of wheat crop. Wheat uptakes P about 0.5-0.6 pounds of P_2O_5 per bushel. Without enough available P within the soil, plants will suffer from deficiencies like stunted growth, purple discoloration of stem and leaves, reduced system and poor tillering. Silicon is that the second most abundant elements within the earth crust. Though they're abundant in earth crust they're not available for the plants as they're locked in soil as recalcitrant minerals. Silicon has been shown to extend resistance to multiple biotic and abiotic stresses, like lodging, disease and pest damage (Ma *et al.,* 2001; Fallah, 2012 and Meyer and Keeping, 2005). High soil sorption of phosphorus (P) in some P deficient low pH soils reduces the efficiency of P fertilizer use and crop yields. By increasing the monosilicic acid concentration within the soil solution, plants are ready to absorb phosphates (P) directly. Matychenkov and Ammosova (1996) had providing when amount of monosilicic acid is increased thanks to chemical resemblance between phosphate and silicate anions causing a competitive reaction within the soil. Walsh *et al.,* (2018) also described that silicon improved plant nutrients uptake and utilization, increased nitrogen and phosphorus use efficiency, thus, lower rates of nitrogen (N), phosphorus (P) and potassium (K) together with Si may leads to higher yields and better quality. By keeping this in mind, an investigation entitled "effect of silicon and phosphorus on growth, yield and quality of wheat in loamy sand" was undertaken.

MATERIALS AND METHODS

A field experiment was conducted at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during Rabi season of 2020-2021. Experimental soil was loamy sand in texture with pH 7.01 and electrical conductivity 0.19 dSm^{-1}. The soil was low in organic carbon (0.39%) and medium in available phosphorus (38.10 kg ha^{-1}) and available potassium (191.25 kg ha^{-1}). Available silicon in soils was 60.75 mg kg^{-1}. Experiment consisted of 4 levels of phosphorus (0, 30, 60 and 90 kg P_2O_5 ha^{-1}) and 4 levels of silicon (0, 100, 200 and 300 kg Si ha^{-1}). Totally sixteen treatment combinations were get into randomized block design with factorial concept and replicated thrice. All the plots received a homogenous recommended dose of nitrogen @ 120 kg ha^{-1}. Grain and straw yield was recorded after harvest of wheat crop. As for the protein content estimation, nitrogen estimation in powered sample of grain was administered using micro Kjeldhal method (Humphries, 1973). The protein content of grain was calculated by multiplying the nitrogen content of grain with a factor of 5.70 and was expressed as per cent on dry weight basis for each treatment.

RESULTS AND DISCUSSION

Grain yield (kg ha^{-1})

The results presented in data illustrate that wheat grain yield was significantly influenced by phosphorus and silicon application. The most grain (3808 kg ha^{-1}) yield was recorded thanks to application of 60 kg P_2O_5 ha^{-1}. The most reason for increase in grain yield with different levels of phosphatic fertilizer may be because of more practical tillers per plant which may well be the result of higher rate of photosynthesis and better crop health which ultimately increased the ultimate grain yield. Plants showed normal growth with the appliance of phosphorus and resulted in improved agronomic traits which lead toward improved grain yield (Sajil *et al.* 2016). Similar findings were reported with Jain and Dahama (2006) and Sharma *et al*., (2012). The significantly higher grain (3619 kg ha^{-1}) yield was recorded thanks to silicon application at 100 kg ha^{-1}; while the bottom grain (2981 kg ha^{-1}) yield was recorded under Si_0. The rise in yield with Si application may well be because of the improving leaf erectness by decreasing mutual shading of leaves, reducing lodging, decreasing the incidence of pathogens and preventing manganese and iron toxicity or both. Application of Si, increased water use efficiency probably may be because of prevention of excessive transpiration. Just in case of interaction effect, combination of phosphorus level *i.e.* 60 kg P_2O_5 ha^{-1} with Si level at 100 kg ha^{-1} showed significantly highest grain yield (4304 kg ha^{-1}). Very cheap grain yield (2565 kg ha^{-1}) was observed in P_0Si_0. Schaller *et al,.* (2019) stated that silicon addition significantly increases phosphorus mobilization by mobilizing Fe (II)-P phases from mineral surfaces.

Straw yield (kg ha^{-1})

Application of various levels of silicon and phosphorus has exhibited a major influence on straw yield of wheat. All-time low straw (4853 kg ha^{-1}) yield was observed under P_0. The most straw (5729 kg ha^{-1}) yield was recorded thanks to application of 60 kg P_2O_5 ha^{-1}. Early tiller formation is important to plant health and ultimately final yield potential. The initial tillers formed by the plant have higher yield potential than late tillers or delayed tillers. When adequate phosphorus is offered in soil, resulting tillers are healthier and productive. The results are in line with the findings of Jat *et al*., (2018) and Singh *et al*., (2018). Significantly highest straw (5584 kg ha^{-1}) yield was recorded thanks to silicon application at 100 kg ha^{-1}; while lowest straw yield (4828 kg ha^{-1}) was recorded under Si_0. The rise in yield with Si application can be thanks to the improving leaf erectness, reduction in lodging and decreasing susceptibility to plant pathogens and pests and preventing manganese and iron toxicity or both. Application of Si, increased water use efficiency probably may be because of prevention of excessive transpiration. Just in case of interaction effect, the best straw yield of wheat crop was observed because of combined application of 90 kg P_2O_5 ha^{-1} and 100 kg Si ha^{-1} (6201 kg ha^{-1}) over the remainder of the combinations. (Ma and Feng, 1990) described that in water culture, when P is low Si causes a decrease in Fe and Mn uptake and thus promotes P availability within the plant. From these findings, it's clear that Si application alleviated the phosphorus uptakes which resulted within the increase in biomass of wheat crop.

Protein content (%) in grain

Protein content in grain wasn't significantly influenced by application of silicon and phosphorus. The most protein content (10.69%) was recorded with 60 kg P_2O_5 ha^{-1} and minimum (9.90%) was recorded with P_0. Just in case of silicon application, the best protein content (10.70%) was observed under the applying of 200 kg Si ha^{-1} and lowest protein content (9.98%) was recorded with control. Interaction effect of phosphorus and silicon are found to be non-significant with relavancy to protein content

CONCLUSION

From this one year experiment, it is clearly shown that application of phosphorus @ 60 kg ha^{-1} and silicon @ 100 kg ha^{-1} together with recommended dose of nitrogen @ 120 kg ha^{-1} has resulted highest grain and straw yield together with protein content in loamy sand soils of North Gujarat.

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Table1: Effect of phosphorus and silicon on grain yield, straw yields and protein content of wheat

Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Protein (%)
Phosphorus levels			
P_0-0 kg P_2O_5 ha^{-1}	2789	4853	9.90
P_1- 30 kg P_2O_5 ha^{-1}	3049	5037	10.17
P_2- 60 kg P_2O_5 ha^{-1}	3808	5729	10.69
P_3- 90 kg P_2O_5 ha^{-1}	3766	5506	10.50
S.Em.±	77.00	118.66	0.31
C.D. (P=0.05)	222.40	342.72	NS
Silicon levels			

Si_0-0 kg Si ha^{-1}	2981	4828	9.98
Si_1-100 kg Si ha^{-1}	3619	5584	10.43
Si_2-200 kg Si ha^{-1}	3459	5417	10.70
Si_3-300 kg Si ha^{-1}	3354	5296	10.13
S.Em.±	77.00	118.66	0.31
C.D. (P=0.05)	222.40	342.72	NS
Interaction			
P x Si	Sig.	Sig.	NS
C.V.(%)	7.96	7.78	10.49

Table2: Interaction effect of phosphorus and silicon on grain yield of wheat

Grain yield (kg ha^{-1})				
Treatments	**Phosphorus levels (kg ha^{-1})**			
Silicon levels (kg ha^{-1})	P_0	P_1	P_2	P_3
Si_0	2568	2579	3123	3653
Si_1	2721	3503	4304	3946
Si_2	3034	3007	3939	3855
Si_3	2832	3109	3866	3610
S.Em. ±	154.00			
C.D. (P=0.05)	444.80			
C.V. (%)	7.96			

Table3: Interaction effect of phosphorus and Silicon on straw yield of wheat

Straw yield (kg ha^{-1})				
Treatments	**Phosphorus levels (kg ha^{-1})**			
Silicon levels (kg ha^{-1})	P_0	P_1	P_2	P_3
Si_0	3739	5087	5450	5036
Si_1	5162	4800	6172	6201
Si_2	5262	4819	6094	5494
Si_3	5249	5441	5201	5292
S.Em. ±	237.33			
C.D. (P=0.05)	685.45			
C.V.(%)	7.78			

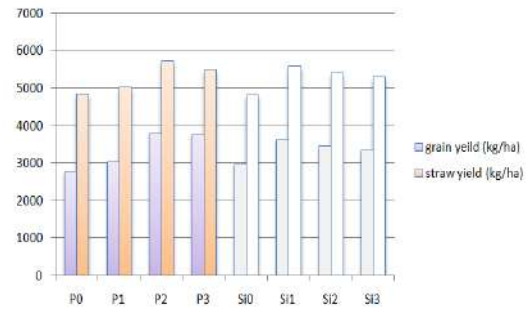

Fig. 1: Effect of different levels of phosphorous and silicon on grain yield and straw yield of wheat.

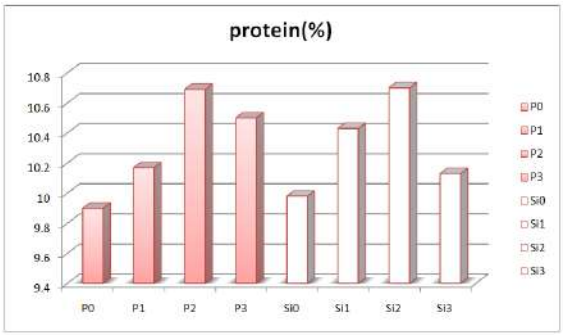

Fig. 2: Effect of different levels of phosphorous and silicon on protein content of wheat.

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REVIEW ARTICLE

Potential use of Nanoparticles for the Treatment of Brain Tumours – A Review

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ABSTRACT

Cancer is one of the widely discussed malignant threats today to human beings. Among all the cancers, the diagnosis, treatment, and management of malignant brain tumours remain to be very challenging. Blood-brain barrier(BBB) permeability is a major challenge for researchers to meet the high demand from patients for treatments. Effective treatment of brain tumour depends on successful drug delivery to the brain. The advances in the field of nanotechnology would greatly facilitate the diagnosis and treatment of brain tumours. Nano-based drug delivery system for treating brain tumours, is a progressing area in the field of precise targeted drug administration methodology. These drug delivery systems are becoming an effective method for overcoming tumour cell-mediated resistance and release the drug to the specific tumour cells. This particular manuscript reviews the current treatment strategies for brain tumour and approaches that are explored in achieving the goals by understanding various advantages of using nanoparticles as drug carriers, an overview of patents as well as and status of clinical trials on nanoparticles for brain tumours.

Keywords: Nanoparticles, Brain tumour, targeted drug delivery, Blood Brain Barrier, lipid nanoparticles, receptor mediated endocytosis

INTRODUCTION

BACKGROUND

Cancer is a class of disorder characterized abnormal proliferation of any of the different kinds of cells in the body [1-2]. Among all the cancers, the diagnosis, treatment, and management of malignant brain tumours remain to be very challenging. Cytotoxicity and limited BBB permeability are some of the most important obstacles for the treatment of brain tumours [3]. Nanotechnology has been extensively studied and exploited for treating cancer as Nanotechnology based drug delivery system have been shown to penetrate the BBB and allow for greater delivery of drug and macromolecules and offer enhanced pharmacokinetic properties of the drug molecule and decreases the side effects by targeted delivery of the drug to the specific site[4-6]. owing to their special physicochemical properties NPs have ability to bypass BBB, without disruption of functionalization of the BBB [7-8]. drugs are actively targeted to the CNS owing to its ability to circumvent BBB, Furthermore, this system may slow drug release in the brain, decreasing peripheral toxicity and dose of the drug compared to the standard doses of free drugs resulting safe drug administration[9]. Nanoparticles developed for brain tumour treatment are mainly made of gold-based(10), silver-based[11], magnetic [12], lipid-based[13], dendrimeric [14] and polymeric nanomaterial [15]. Nanomedicine has also been enormously involved in the diagnosis brain cancer with higher sensitivity, cost-effectiveness and minimized overdiagnosis and underdiagnosis of cancer [16]. The idea that drug or device delivery vehicles can be produced by nanoengineering that can differentiate tumours from normal tissues for increasing survival persists, limiting toxicity, and improving efficacy. As it is known that brain tumours have a poor prognosis, and the primary reason is that struggling of cancers for passing through the blood-brain barrier is destroyed by the conventional chemotherapy treatments, which means that in an adequate concentration they don't reach the tumour to be effective. Over the recent years, the use of nanoparticles has been fruitful due to the nanoparticles being transported across the BBB, making nanoparticles potent as nanocarriers for brain tumours' efficient treatment in comparison to various conventional chemotherapy treatments [17].

Pathophysiology of the Disease

Figure 1: pathophysiology of brain tumour

The Blood-Brain Barrier and Drug Delivery:

Brain homeostasis is maintained with the help of CNS (Central Nervous System) barrier through regulation of toxic substances' efflux and endogenous nutrients' influx. Primarily, brain consists of barriers, which are the "blood-cerebrospinal fluid barrier (BCFB)" and the Blood-Brain Barrier (BBB), limiting the CNS diseases treatment options by obstruction imposing for various promising drug substances' entry for disorders of brain. Restricting unconfined access to the CNS, by CNS drug candidates leads to a lack of therapeutic concentration at the required brain location that in response, lowers the CNS drug candidate's therapeutic efficacy.(18) The BBB is a diffusion barrier that is necessary for the brain to operate normally. It prevents chemicals from the blood from entering the brain, preserving brain homeostasis. Physically tight brain capillaries are created in the BBB by brain microvascular endothelial cells (ECs), pericytes, astrocytes, tight junctions (TJs), neurons, and basal membrane. The lack of fenestrations in the brain capillary ECs restricts the diffusion of proteins and small molecules. The ECs are connected to a continuous barrier by interendothelial junctions, which severely limits the entrance of chemicals that are water soluble. The impermeable BBB is formed of pericytes, astrocytes, and basal membrane surrounding the ECs. A further barrier to chemicals entering the brain is the presence of efflux transporters in brain capillary ECs. Interendothelial junctions, which are protein complexes like adherens junctions, TJs, and gap junctions, primarily regulate the permeability of the BBB. Adherens junctions essentially control the endothelial barrier's permeability. TJs are essential for maintaining the ECs' and epithelial cells' permeability barriers, which regulate tissue homeostasis. Six connexin molecules make up gap junctions, which enable direct electric and chemical communication between ECs. The BBB's elements don't have a static structure; they constantly adjust in response to the brain's varied physiological changes[19].Paracellular or transcellular pathways are used to transport molecules over the blood-brain barrier (BBB) (through the cells). Ions and solutes can traverse the BBB by passive diffusion by using concentration gradients for

the paracellular route. The transcellular route uses a variety of processes, including transcytosis, passive diffusion, and receptor-mediated transport. Passive diffusion is, in general, a non-saturable mechanism that depends on the physicochemical characteristics of the molecule. The physical elements that impact BBB permeability are molecular weight, charge, lipid solubility, surface activity, and relative molecule size . By passive diffusion over a transcellular route, small lipophilic substances like carbon dioxide can pass through the BBB[20]. Additionally, physiological elements such plasma protein binding, enzymatic activity, efflux transporters like P-glycoprotein (P-gp), efflux transporters, and cerebral blood flow might affect BBB permeability. Through specialised and saturable receptor-mediated transport pathways including the glucose transporter-1 (GLUT-1), insulin transporter, and transferrin transporter, hydrophilic molecules like proteins and peptides enter the brain. The luminal and abluminal EC membranes exhibit these endogenous transporters. In order to transfer medications to the brain, receptor-mediated transcytosis has been thoroughly researched among these transport systems. New methods for medication administration to the brain will be developed as a result of a greater knowledge of the mechanisms of passage over the BBB[21].

BBB Transport mechanism

BBB can only be crossed by lipophilic compounds with positive charges as well as lower molecular weights (less than 400–600Da). Specific cell endogenous transport mechanisms are needed for other substances. There are usually four major processes through which solute molecules pass across membranes[22].

Paracellular Diffusion

It is a non-competitive as well as non-saturable process involving the molecules movement over the intercellular space's aqueous route between cerebral microvessels' endothelial cells in tight junctions through tiny pores. The tight junction formation between the endothelial cells restricts the entry of most of the drugs other than small polar molecules, which can diffuse via aqueous pores through the BBB [23].

Carrier Mediated Diffusion

Carrier Mediated transport is an energy-dependent pathway. The substances, like nutrients, movement between the brain and the blood interstitial fluid for transporting substrate against the concentration gradient needs highly selective membrane-bound carrier system. Few drugs can be transported by this method by imitating the endogenous nutrients or by appropriately modification to emulate them. The modified substances are transported throughout the BBB through those biological carrier transportation system, which have the substrate binding mechanism to the carrier protein, which results in the pores formation, then transporting the substratum molecule throughout the BBB, resulting in the substrate molecule release into the brain's other hand. For nutrients, concentration gradients are usually in blood to the brain direction. Further, ions, amphipathic molecules, hormones, purines and pyrimidine bases, nucleosides, vitamins, amino acids and monosaccharides' transportation into the brain is eased by the specific carrier proteins. For the brain, the primary energy source is glucose; hence glucose transporters (GLUT3and GLUT1, sodium independent facilitative transporters) at the BBB having high significance since high energy and glucose demands are maintained by these transporters in the brain[22,23].

Transcellular Diffusion

Transcellular diffusion involves the solutes' transportation across the cell. Highly lipophilic molecules and drugs with small molecular sizes can diffuse passively down their concentration gradient across BBB. The transport through passive diffusion is primary influenced by the factors protein binding, lipophilicity, molecular weight and drug ionization. Lipophilicity is calculated in logP terms; high logP results in the high BBB permeability. Molecules with below 400Da molecular mass notably undergoes free diffusion through the BBB. Usually, it has been supposed that BBB penetration is not easy for high electrical charge molecules; whereas through diffusion mechanisms, BBB is easily crossed by low molecular weight lipophilic Drugs[23].

Receptor-Mediated Endocytosis

RMT (Receptor-mediated transport) includes the brain ECs vesicular trafficking system for delivering various proteins such as rabies virus glycoprotein, lipoproteins, leptin, folates, angiotensin II, insulin-like growth factors, insulin and transferrin to the brain. Receptor-mediated endocytosis mechanism includes circulating ligand binding to a particular receptor of transmembrane which are expressed on endothelial cells' apical plasma membrane. (For example, transferrin receptor is binded by transferrin). Eventually, endocytosis occurs as the cluster of receptor-ligand complexes, as well as membrane infolding resulting in the intracellular transport vesicle formation which contains complexes of receptor-ligand, following intracellular vesicular trafficking wherein there is movement of vesicles across the cell's interior membrane. Vesicles that carry receptor-ligand complex or contain distorted ligands are transported to the polarized endothelial cell's basolateral side; there is exocytosis wherein vesicular content is released into the brain parenchyma, and this process is known as transcytosis. Low-density lipoprotein receptors mediate the transport of LDL. The Apo-lipo proteins' expression including ApoB and ApoE on the LDL surface acts as a ligand as well as enables the lipoprotein particles' receptor-mediated endocytosis to cells; this method is used for targeting the therapeutics to the brain through particle coating with the ApoE. Efflux carriers' expression on the BBB's abluminal and luminous side greatly reduce the various treatments permeability as well as a wide variety of toxins which might otherwise easily spread through this membrane. ABC efflux transporter P-glycoprotein (P-GP) is considered as most significant efflux transporter which facilitates the substrates efflux, which back into the capillary lumen includes relatively lipophilic compounds. Various toxins and therapeutics' permeability across plasma membranes is restricted significantly through these efflux transporters which else diffuses easily through this membrane [24,25].

Current treatment methodologies to treat brain metastasis

For facilitating the drug molecules crossing the BBB, method
s such as non-invasive and invasive were adopted; BBB is considered as the major obstacle which prevents therapeutic agents' efficient delivery in the brain. Majorly, invasive methods depend on BBB integrity which is disrupted through direct intracranial drug delivery with the help of biochemical, osmotic pumps, intrathecal or intracerebral administration, intra-cerebroventricular mean. In comparison, non-invasive methods including prodrug approach, intranasal drug delivery, vector/receptor-mediated drug delivery, chemical drug delivery, carrier-mediated drug delivery, as well as drug moieties modification into lipophilic analogue. For brain drug delivery, there is wide experimentation going on with colloidal-based novel drug delivery system. Such novel carrier systems' advantage is their abilities for protecting the active drugs from enzymatic inactivation and degradation, their abilities for enhancing tissue targetability and specificity through suitable targeting moieties, and their abilities for changing the active drug's physicochemical parameters [18].

Nanotechnology based drug delivery system

Nanotechnology based drug delivery system offers a comprehensive platform for developing efficient therapeutic nanomaterial in a biological system which precisely interacts with a target and desired response is induced. Targeted drug delivery is beneficial as it protects the healthy cells from the cytotoxic compound, fighting the drug-resistant cancerous cells and reducing the dose-limiting adverse effects. Due to special cell absorption and trafficking processes, nanoparticles enable the sensitive therapies delivery in active form to their particular lesions as well as reduces amount accumulated in undesirable tissues/organs. But the cytosolic ingestion of a medication molecule does not require contact with its subcellular objective has become more obvious[27]. Nanotechnology is undergoing experimental research in place to enable medication transfers throughout the BBB. Capillary endothelial cells and related pericytes in tumours may be aberrant, as well as the BBB in brain tumours may not always be intact. Other variables like astrocytes might assist to brain tumour resistance to nanoparticles treatment. Careful design and optimization of nanoparticles is therefore essential in order to allow nuclear/cellular targeting[28].

Different types of nanoparticles used for brain tumour treatment

Polymeric Nanoparticles

Polymeric NPs (nanoparticles) consists of active compounds surface-adsorbed or entrapped within the polymeric core as well as size ranges from 1-1000nm. PNP's are highly stable, have an efficient drug loading capacity, and provide controlled drug release from nanoparticles. The surface may be easily changed by adding appropriate ligands that provide a various drug range at a specific site with greater efficiency. The surface covering with an inert polymer comprising PEG that in general acknowledged as safe, is a method that improves circulatory life by avoiding interactions with bloodstream components for effective BBB medication delivery[29]. Wohlfart et al. demonstrated that doxorubicin delivery is enabled by the poloxamer188-coated PLGA nanoparticles in the therapeutically efficient concentrations across the BBB using a rat glioma model. Across the BBB, for their transport basis was hypothesized for blood apolipoproteins adsorption (ApoA-I or ApoE) on the nanoparticles surface because of the coating of poloxamer 188, following nanoparticles RMT[30].

Polymeric Micelles

Nanoscale shell/core structures are produced by copolymers of amphiphilic block in polymeric micelles. Micelles made of polymeric materials have both adjustable and inherent characteristics that make them especially suitable for purposes of drug delivery. Micelles have acquired wide consideration due to their ability for improving drug ADME (Adsorption, Distribution, Metabolism, and Elimination) properties to treat various diseases. Drugs having low permeability, such as hydrophobic drugs, encapsulated into micellar nanoparticles for improving efficacy. Also, therapeutics are protected by micelles against degradation[31].

Nanogels

Nanogels are nanosized hydrogel material developed through networks of chemical or physical cross-linked swellable polymers, water holding capability in a more considerable amount without aqueous medium dissolvation. Advantages of nanogels include desirable mechanical and biocompatibility properties. Such hydrogel nanoparticles have both the nanoparticle and hydrogel's characteristics and features. These particles' properties such as biocompatibility, high water absorptivity, versatility, flexibility, and hydrophilicity can enhance the therapeutics lifespan in the bloodstream as well as specific site is targeted[32]. Li *et al.* showed biodegradable nanogel as an intracellular therapeutic delivery platforms[33].

Magnetic Nanoparticles

Magnetic Nanoparticles (MNPs) are efficient and non-invasive and are used to diagnose and treat CNS disorders. A significant feature of the MNP'S is that they can pass through the BBB due to properties including abilities for improving MRI contrast, abilities for targeting the diagnostics/drug to a specific site, and high permeability across BBB. Site-specific delivery enhances the uptake of the therapeutic agent and results in greater efficacy with a minimum dosage[34,35].

Solid Lipid Nanoparticles (SLN)

They are spherical nanoparticles which to conventional colloidal carriers present an alternative delivery system. They are combination of polymeric nanoparticles, liposomes, and emulsions' advantages as well as for overcoming few issues in the formulation toxic substances as well as organic solvents are avoided. Their benefits include improved protein stability, entrapped drug protection against degradation, good tolerability, exceptional physical stability, good biocompatibility, incorporated molecules' preventing proteolytic degradation, as well as their surface functions with several agents like for brain apolipoprotein E is used which targets limiting the RES uptake thus to enhancing the bioavailability. However, SLN has a few limitations, such as low entrapment efficiency, during storage after polymorphic transition drug expulsion[36,37].

Nanostructured Lipid Carriers

Müller et al. developed NLCs to subdue the SLNs' drawbacks, which includes to show improved stability, drug expulsion problems and to improve entrapment efficiency [38]. The highly ordered crystalline structures are not

contained by the NLCs, therefore expulsion of loaded drug is prevented. They are solid lipid nanoparticles of second generation. A few advantages of NLC include drug loading capacities and higher stability[39], as well as for human application it is approved and remain well-tolerated and demonstrates good stability upon long-term storage[40].

Other Colloidal Carriers

Theranostic Nanomedicine

Theranostic nanomedicine is a novel and promising therapeutic area which integrates diagnosis and therapy in a single window. Theranostic nanomedicine generally takes the benefit of nano-systems through radiation imaging agents delivery, including quantum dots, carbon nanotubes, silica nanoparticles, gold nanoparticles, and iron oxide nanoparticles. For providing the proper treatment to a particular individual, it overcomes the one medicine fits all. [41].

Gold Nanoparticles

Recently, GNPs (Gold nanoparticles) have evolved as an exciting contender for various capacities' targeted delivery to their particular sites. GNP's exhibit their unique physical as well as chemical properties for unloading and transporting pharmaceuticals. The gold nanoparticles have presented benefits such as nontoxic gold core, inert nature, as well as are easy to synthesize. However, toxicity issues with gold core could arise from ligands used due to their interactions with the cell membrane. Yu Cheng et al. demonstrated that Pc 4-loaded Au NPs' EGF targeting to the receptor's cell surface considerably improved their capacities for delivering drug cargo into brain tumours. [42].

Nanoparticles and their significance in the treatment of Brain Tumour:

Solid colloidal particles are nanoparticles comprise of macromolecular materials here active principle is dissolved or entrapped. Nanoparticles 'characteristics which makes them appropriate for tutor treatment are their surface charge, small size, , prolonged time in circulation. By modifying the particle surface and particle size, drug permeation across BBB could be enhanced as well as can deliver therapeutic efficacy at the target location.The nanoparticles' shape is a key factor since it affects the particle uptake and fluid dynamics. The present applications deals with utilizing spherical nanoparticle because of their application and synthesis ease. Furthermore, nanoparticles' stability depends on the surface charge that also affects their bloodstream distribution. Earlier researches has proved that in targeting tumour vessels, positively charged nanoparticles are more efficient. Nevertheless, neutrally charged nanoparticles replaced them that faster extravasate into the tumour tissues[58]. This method can protect drugs against enzymatic degradation, enhance the poorly soluble drugs' solubility and provides sustained release. Thus, nano-carrier and nanotechnology-dependent systems can improve the drugs' therapeutic efficacy and bioavailability. In general, for achieving the favorable drug safety, improved efficacy, and drug pharmacokinetics, nano carrier-based delivery system are utilized [59].

Status of clinical trials on nanoparticles for brain tumour

The ultimate test of a field's success is the ability to translate research results from the laboratory to the clinic, notwithstanding how successfully researchers have used nanotechnology to address and resolve many crucial concerns in the laboratory. Right now, different nanotechnology-based formulations are in clinical preliminaries, and a lot more are approaching.

Patented nanoparticles systems for brain tumour treatment

For over a decade, there has been a significant move towards developing and protecting new inventions on nanoparticle systems for brain tumour treatment. Nanoparticulate systems of different compositions such as polymeric NPs, inorganic NPs, and lipid NPs have been investigated. Patented nanoparticles for brain tumour treatment have been listed in the table.

CONCLUSION

The treatment of brain tumours (or more generally, CNS tumours) is particularly challenging, mainly because of physiological barrier BBB and morphological properties of the drug delivery system. Nanotechnology based formulations is on increasing demand owing to its therapeutic and diagnostic properties. These formulations offer many more possibilities than conventional chemotherapy treatments for treating brain tumours. Several nanoparticle formulations are showing promising effects in rodent models mainly by employing protein targeting moieties. However, only a few number of nanomedicines have entered clinical trials, and the majority of them include drug-loaded nanocarriers without targeting ligands, possibly due to concerns about safety and scalability.

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Table 1. Treatment strategies for brain tumour.

S.No	Treatment	Process	Mechanism	Reference
CONVENTIONAL TREATMENT STRATEGIES				
1	**Surgery**	Involves removal of macroscopic tumour	NA	(26)
2	**Radiation therapy**	The high-powered rays use damage cancer cell as well as stop their growth	NA	(26)
3	**Chemotherapy**	Chemotherapy is the drugs or drugs' combination use to destroy cancer cells.	NA	(26)
NOVEL TREATMENT STRATEGIES				
1	**Prodrug Approach**	Lipidization strategy, Receptor-Mediated Prodrug delivery	Lipophilic bio-removable target increases drugs' lipophilicity for facilitating BBB crossing, resulting in locking of the drug in the brain, which prevents them from BBB effluxing out.	(26)
2	**Colloidal Based**	They change the physicochemical properties of active drugs, improve tissue targetability and specificity and protect the active drug from degradation.	Targeting by Receptor-Mediated endocytosis,Transcytosis,paracellular- refer	(26)

Table 2. Nanoparticles for Brain tumour treatment.

Type of nanoparticles		Drug/Delivery System	Major finding	Reference
Lipid Nanoparticle	Lipid Nanocapsules	paclitaxel-loaded lipid nanocapsules	Increased survival rate when tested on mice	(43)
	Lipid Nanocapsules	ferrociphenol lipid nanocapsules	Nanoparticles exhibited synergistic antitumour activity	(44)
	Solid Lipid Nanoparticle	Camptothecin	Physical stability of the particle under physiological pH	(45)
	Solid Lipid Nanoparticle	Rutin-loaded solid lipid nanoparticles	Formulated rutin-loaded SLNs were stable in circulation, Thus, rutin-encapsulated SLN formulations can be used as a promising vector to target tumours across BBB.	(46)
	Solid Lipid Nanoparticle	Paclitaxel and naringenin-loaded solid lipid nanoparticles	Better chemoprotective effect over the plain drug solution	(47)
	NLC	Garlic oil	The garlic NLC improved the permeability of garlic oil to cross the blood brain barrier.	(48)

	NLC	SN38 loaded nanostructured lipid carriers	Increased cellular uptake and significant more cytotoxicity	(49)
Magnetic Nanoparticle	Iron Oxide Nanoparticles	polyethyleneimine (PEI)-modified magnetic nanoparticles	GPEI exhibited high cell association and low cell toxicity	(50)
	Iron Oxide Nanoparticles	Dextran-coated magnetic iron oxide	Increased Targeted Delivery	(51)
	Iron Oxide Nanoparticles	Genistein and Temozolomide	Decreased U87MG cell proliferation, hence improves anti-tumour activity.	(52)
Polymeric Nanoparticle	Polymeric Nanoparticle	SN-38 is a topoisomerase I (TOP1) inhibitor.	Accumulation of drug Loaded Nanoparticles in Mouse Brains after IV Administration	(53)
	Polymeric Nanoparticle	Paclitaxel/etoposide co-loaded polymeric nanoparticles	Enhanced cytotoxic effect indicated by lower IC50 values and augmented cell apoptosis to U87 and C6 glioma cell lines compared to both free drugs.	(54)
	Polymeric Nanoparticle	Topotecan in poly(lactic-co-glycolic acid) (PLGA) polymeric nanoparticles	PLGA polymer was stable from hydrolysis and present in an active form for a longer time in the body.	(55)
Theranostic Nanoparticle	Gold Nanoparticle	Docetaxel (DCX) and glutathione reduced gold nanoparticles (AuGSH)	Increased Targeted Delivery	(56)
	Silica Nanoparticle	Doxorubicin and Paclitaxel	Increased Cytotoxicity-In Vitro, Strongest inhibition of tumour growth-In Vivo	(57)

Table 3. Clinical Trials Data.

Study Number	Nanoparticle type	Indication	Drug	Study Phase	References
NCT03020017	Gold	Gliosarcoma, recurrent glioblastoma	NU-0129	Completed	(60)
NCT02820454	Polymer-gadolinium chelates	Brain metastases	AGuIX (polysiloxane gadolinium-chelates based nanoparticles) concurrently with whole-brain radiation	Completed	(60)
NCT00734682	Liposome	Recurrent high-grade gliomas	CPT-11	Phase I	(60)

NCT02340156	Cationic liposomes	Recurrent glioblastoma	Liposomes encapsulated p53 cDNA in combination with oral temozolomide	Phase II	(60)

Table 4: **Patents data**

Patent number	Title of patent	Type of nanoparticle	Author	Reference
EP20071819723A	Drug delivery peptides for BBB crossing	Polymeric Nanoparticle	Forni F et al	(61)
US20110077204	Agent for targeted drug delivery to cerebral neurons	Polymeric Nanoparticle	Kuchiiwa S et al.	(62)
US20067025991	Drug targeting system, method of its preparation, and its use	Polymeric Nanoparticle	Sabel BA et al.	(63)
EP20112547329	Theranostic delivery systems with modified surfaces	Theranostic Nanoparticle	Ferrari M et al.	(63)
US20100076092	Lipid-derived nanoparticles for brain-targeted drug delivery	Lipid Nanoparticle	Panyam J et al.	(64)
US20020025313	Targeting of liposomes to theBBB	Lipid Nanoparticle	Micklus MJ et al.	(65)
US20110054236	Compositions and methods for targeting tumours	Inorganic Nanoparticle	Yang VC et al.	(66)
EP20051581186	Artificial low-density lipoprotein carriers for transport of substances across BBB	Lipid Nanoparticle	Alkon LD et al.	(67)

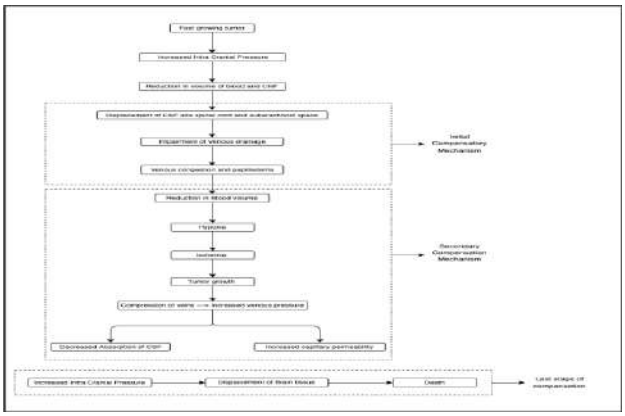

Figure 1: pathophysiology of brain tumour

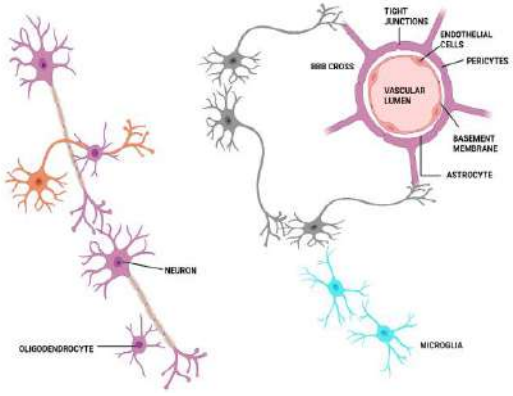

Figure 2: Structure of BBB

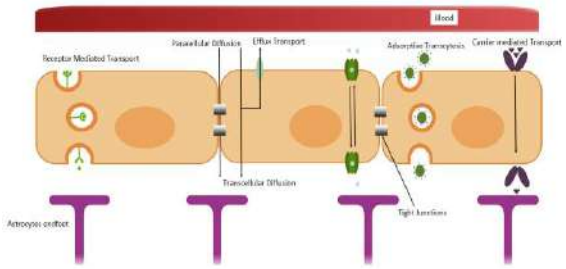

Figure 3: Transport Mechanism across Blood brain barrier

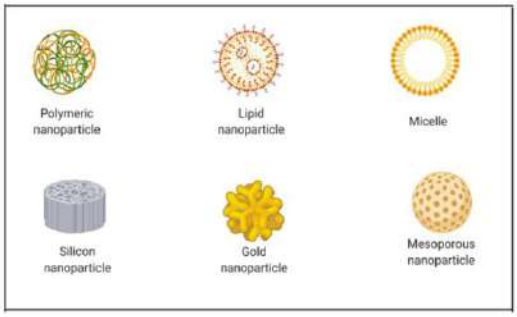

Figure 4: Types of Nanoparticles

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RESEARCH ARTICLE

Perceived Effectiveness of E-Resources among the Research Scholars of Faculty of Agriculture, Annamalai University, Chidambaram, Cuddalore District, Tamil Nadu

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ABSTRACT

The growth of internet has emerged as the powerful tool and changed the methods of research, storage, retrieval and communication of scholarly information in higher education system. The use of different e resources enabled the users to retrieve relevant information. The growing importance of e resources in education and research agricultural educational institutes are stepping ahead to keep pace with the latest advances in information technologies. The technological developments are also influencing research scholars information seeking behaviour and tools and techniques of information seeking. Hence, the present investigation was designed to study the perception towards e resources by the research scholars of faculty of agriculture Annamalai University. The study findings revealed that majority of the research scholars had medium level of perception towards e-resources. The mean score for the e-resources are high in offline portable computers (CD / DVD, Pendrive, hard disk) (4.69MS), Presentation software (4.54MS) and DOAJ (4.48MS). The mean scores of the positive statement were high and the mean scores of the negative statement were low.

Keywords: communication, positive, agricultural, storage, statement

INTRODUCTION

The advancements in information technology have forced the libraries and information centers to go in for the changes in the information services. In the 21st century many libraries are likely to use the on-line information retrieval facility for the services. The electronic resources become inevitable collections in the University libraries. Print media are being digitalized and it increases the availability of book and journals in the electronic formats. The electronics books are helpful due to their portability and feature of incorporating more than one book in a single hand held device. The published materials are also available on open access. This also helps the students to get the required information free of cost.

Key words: Perception, Effectiveness, e resource and Research Scholar
The present study has formulated with the following objectives.
1.To identify and select the various e resources facilitates agricultural education.
2.To assess the perception and useful
ness of e resources among the research scholars.

LITERATURE REVIEW

Garhwal (2010) observed that majority (50.58 per cent) of male agricultural students and 35.71 per cent of female agricultural students were between 21-25 years of age. Moussa (2012) reported that majority (42.22 per cent) of the respondents possessed two e-mail identities and (59.26 per cent) with one e-mail identities. Baladhandayutham (2015) reported that majority (59.26 per cent) of the respondents are from rural background and (40.74 per cent) of the respondents are from urban background. Okafor (2015) observed that 59.50 per cent of the respondents had computer of their own and the remaining 45.50 per cent of the respondents did not owned computer. Mwantimwa et al., (2017)observed that 40.30 per cent of the academic staff perceived access towards e-resources to be very easy and 45.4 per cent to be easy. Haque and Hoq (2018) observed that the student's perception about the usefulness of electronic resources is very positive. About 50 per cent of the respondents believed that e-resources are useful tool for study purposes, followed by 39.13 per cent of the respondents believed that e-resources are useful.

MATERIALS AND METHODS

The present investigation was carried out in the Faculty of Agriculture, Annamalai University.The sample size consisted of 120 post graduate and doctoral research scholars were selected through proportionate random sampling. The total number of departments in the Faculty of Agriculture is 09 and thesamples selected for the study are as shown in Table 1.

FINDINGS AND DISCUSSION

In the 21st century information technology had brought rapid changes in education. The conventional teaching and learning is gradually moving towards online. The concept of digital library, virtual library and electronic library came into present situation. For teaching and learning in agriculture electronic resources are available in web enabled medium. To find out the perception of research scholars towards various e resources data were collected and the results on perception towards e resources among the research scholars are discussed here.

Overall perception of e-resources
The results on overall perception towards e resources are given in Table 2.

The results revealed that majority (55.00 per cent) of the respondents are having medium level of perception towards e-resources, followed by i(34.17 per cent) high and 10.83 per cent of respondents are having low level of perception.

Category wise perception of e-resources

E resources are resources in which information is stored electronically and are accessible through electronic systems and networks. E resource is a broad term that includes a variety of publishing models, including OPACs, CD-ROMs, online databases, ejournals, ebooks, internet sources, print on demand, e mail publishing, wireless publishing, electronic link and web publishing etc., The selection of e resources are based on their availability in university libreary, experts opinion and familiarity of research scholars. The results are given in Table 3.

An over view of the table revealed that the opinion of the research scholars according to the usefulness of e-resources are high in offline portable computer database (CD/DVD, Pendrive, Hard disk) (4.69MS), Presentation Software (4.54MS), DOAJ (4.48MS), e-library (4.41MS), Springer link (4.39MS), CeRA (4.35MS), Annual reviews (4.28MS), Economic and political weekly and e-magazine (4.26MS), IAS (4.07MS), Taylor and Francis and Wiley-Blackwell Publishing (4.05MS), NISCAIR (4.01MS) followed by e-Analysis of data (3.77MS), AGRICOLA (3.64MS), McGraw-Hill education (3.46MS), OPAC (3.19MS), e-reprint (3.01MS), SCOPUS (2.88MS), PROQUEST (2.79MS), Amazon-Kindle (2.52MS) and AgNIC (1.63MS), AgREN (1.52MS) are low.

Statement wise perception towards e-resources

The results on perception and usefulness of e resources statements were formulated, mean scores were worked out and results are given in Table 4. From the table it could be inferred that among the 19 perception statements, the mean score of the statements The electronic resources are valuable (4.76MS), Opportunities for sharing (4.65MS), e-resources provide up-to-date information (4.61MS), I highly depend on e-resources to prepare my assignments or research report (4.33MS), e-resources help my learning activities (4.32MS), The e-resources provide better way of relaxation (4.27MS), Remote access (could be read from remote location) (4.24MS), e-resources are easy to use and I feel I gain a lot by using e-resources (4.04MS), Quick search and retrieval (4.02MS), Online information resources are expensive (3.86MS), I am motivated anytime I use the e-resources for learning (3.83MS), and The e-resources are more useful than printed resources (3.81MS) are found to be higher. It indicates the most favourable opinion towards e-resources statements are of positive nature. The less favourable opinion towards e-resources are of negative nature and received minimum scores for the statement It does not give the full satisfaction of reading (1.87MS).The statements Searching on the internet is difficult (3.62MS), It's value is over estimated, there is no real benefit in using e-resources (3.54MS), I am satisfied with the facilities to access online resources in our University (3.43MS), It is not easy to use (3.35MS), e-resources are not reliable (3.14MS)received medium mean scores that indicates the favourable opinion as perceived by the research scholars towards e-resources statements.

SUMMARY AND CONCLUSION

Hence it could be concluded that half proportion (56.67 per cent) of the research scholars belongs to the age group of 24-27. Three fourth (75.00 per cent) of the research scholars had B.Sc. (Ag) degree. Nearly 46.67 per cent of the scholars had semi-urban background. Majority (89.17 per cent) of the research scholars had personal e-mail ID. Nearly 47.50 per cent of the research scholars had laptop. Majority (55.00 per cent) of the research scholars had medium level of perception towards electronic resources followed by high level (34.17 per cent) and low level (10.83 per cent). Among the various electronic resources the mean score for the e-resources are high in offline portable computers (CD/DVD, Pendrive, hard disk) (4.69MS), Presentation software (4.54MS) and DOAJ (4.48MS). Among the 19 perception statements, the mean scores for the statements The electronic resources are valuable (4.76MS), Opportunities for sharing (4.65MS), e-resources provide up-to-date information (4.61MS), I highly depend on e-resources to prepare my assignments or research report (4.33MS), e-resources help my learning activities (4.32MS), The e-resources provide better way of relaxation (4.27MS), Remote access (could be read from remote location) (4.24MS), e-resources are easy to use and I feel I gain a lot by using e-resources (4.04MS), Quick search and retrieval

(4.02MS), Online information resources are expensive (3.86MS), I am motivated anytime I use the e-resources for learning (3.83MS), and The e-resources are more useful than printed resources (3.81MS) are found to be higher. It indicates the most favourable opinion towards e-resources statements are of positive nature.

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Table 1. Departmentwise distribution of research scholars

Sl. No	Name of the Department	Total number of Research Scholars	Sample Selected
1	Department of Agronomy	41	20
2	Department of entomology	25	12
3	Department of Plant Pathology	27	13
4	Department of Microbiology	21	10
5	Department of Soil Science and Agricultural Chemistry	16	8
6	Department of Genetics and Plant Breeding	25	12
7	Department of Horticulture	42	20
8	Department of Agricultural Economics	26	13
9	Department of Agricultural Extension	24	12
	Total No. of Sample Selected	247	120

Table 2.. Distribution of respondents according to their perception towards e-resources

(n=120)

Sl. No	Category	Number	Per cent
1	Low	18	10.83
2	Medium	80	55.00
3	High	22	34.17
	Total	120	100.00

Table 3 .Distribution of respondents according to their category wise perception of e-resources

(n=120)

Sl. No	e-resources	Mean score
	A) ONLINE RESOURCES	
1	**e-journals**	
i)	Annual reviews	4.28
ii)	Taylor and Francis	4.05
iii)	Wiley-Blackwell Publishing	4.05
iv)	Springer link	4.39
v)	Economic and Political Weekly	4.26
2	**e-books**	
i)	McGraw-Hill education	3.46
ii)	Amazon-Kindle	2.52
3	**Databases**	
i)	OPAC	3.19
ii)	AGRICOLA	3.64
4	**Open access resources**	
i)	DOAJ	4.48
ii)	NISCAIR	4.01
iii)	IAS	4.07
5	**Web portals**	
i)	SCOPUS	2.88
ii)	PROQUEST	2.79
6	**Websites**	
i)	AgNIC	1.63
ii)	AgREN	1.52
iii)	CeRA	4.35
iv)	e-magazine	4.26
v)	e-analysis of data	3.77
vi)	e-library	4.41
vii)	e-reprint	3.01
	B) OFFLINE RESOURCES	
1	Offline Portable Computer Database(CD/DVD, Pendrive, Hard Disk)	4.69
2	Presentation Softwares	4.54

Table4. Distribution of respondents according to their statement wise perception of e-resources.

(n=120)

Sl. No	Statements	Mean score
1	e-resources are easy to use	4.04
2	Quick search and retrieval	4.02
3	Opportunities for sharing	4.65
4	Remote access (could be read from remote location)	4.24
5	e-resources provide better way of relaxation	4.27
6	e-resources provide up-to-date information	4.61
7	I am satisfied with the facilities to access online resources in our university	3.43
8	Online information resources are expensive	3.86
9	Searching on the internet is difficult	3.62
10	I feel I gain a lot by using e-resources	4.04
11	The electronic resources are valuable	4.76
12	I am motivated anytime I use the e-resources for learning	3.83
13	I highly depend on e-resources to prepare my assignments or research report	4.33
14	e-resources help my learning activities	4.32
15	The e-resources are more useful than printed resources	3.81
16	e-resources are not reliable	3.14
17	It does not give the full satisfaction of reading	1.87
18	It is not easy to use	3.35
19	Its value is over estimated, there is no real benefit in using e-resources	3.54

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REVIEW ARTICLE

Inflammatory Markers and its Association with Periodontal Disease: A Review Article

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ABSTRACT

Periodontal disease (PD) is one of the most common oral conditions affecting both youths and adults. Periodontal diseases are initiated by consortia of oral bacteria that elicit local inflammatory responses that lead to bleeding on probing (BOP), loss of periodontal attachment, bone, and eventual tooth loss. Among cell activity markers, elevated levels of alkaline phosphatase (ALP), lactate dehydrogenase (LDH), aspartate amino transferase (AST), alanine amino transferase (ALT), and matrix metalloproteases (MMPs) have been associated with PD. The relationship between periodontal disease and the role of inflammatory mediators is a current subject of discussion and controversy. The present review was conducted to assess the periodontal status with serum IL-6, LDH, CRP level in chronic periodontitis.

Keywords: Periodontal disease; Inflammatory markers; C-reactive protein; interleukin-6 (IL-6); Lactate dehydrogenase (LDH)

INTRODUCTION

The global burden of oral conditions has been shifting from severe tooth loss in recent decades toward severe periodontitis and untreated caries. Periodontal diseases are very common and are supposed to affect up to 90% of the world's population in the course of their individual lives[1,2]. Periodontitis is known as a complex infectious disease, and may begin in childhood or adolescence, but most of all, clinically manifests itself in early adulthood, and less often, in later years. It is characterized by primary reversible and than permanent histopathological disorders[2].

Clinically periodontitis appears primary as the inflammation process of soft tissue (gingivitis), followed by hard tissue alterations like alveolar bone loss and dental cementum pathologies. If not treated properly, this condition leads to increased tooth mobility due to the loss of tooth attachment apparatus, as a result of the destruction of periodontal ligaments (PDL), and ultimately tooth loss. Periodontal diseases are initiated by consortia of oral bacteria that elicit local inflammatory responses that lead to bleeding on probing (BOP), loss of periodontal attachment, bone, and eventual tooth loss[1]. They have been linked to systemic conditions including heart disease, diabetes, obesity, and complex metabolic syndrome. The association between periodontal diseases and these systemic conditions seems to be due to a low-grade inflammatory burden that links them through a common patho-physiological mechanism. Conceivably, locally secreted cytokines and periodontal pathogens can enter the bloodstream and contribute to damage elsewhere in the body, and there has been a substantial evidence to support this hypothesis[2].
In the past decade, there has been a renewed interest to study the effect of periodontitis on changes in the cellular and molecular components of peripheral blood. The relationship of periodontitis with leukocytes, thrombocytes, C-reactive protein, interleukin-6 (IL-6), fibrinogen, erythrocyte sedimentation rate (ESR), Von Willebrand factor, and red blood cells has been investigated in a large number of studies [3]. IL1β, TNF-α, IL6, and the receptor activator of nuclear factor κB ligand (RANKL), among other cytokines, are known to be involved in immune response regulation in PD and to play a key role in its development[4]. IL6. It is produced by numerous cells of the periodontium in response to IL1β and TNF-α secretion, playing a major role in the activity of immune cells and osteoclasts and the inflammatory response to bacterial plaque formation [5].

Among cell activity markers, elevated levels of alkaline phosphatase (ALP), lactate dehydrogenase (LDH), aspartate aminotransferase (AST), alanine aminotransferase (ALT), and matrix metalloproteases (MMPs) have been associated withPD[6].Salivary lactate dehydrogenase (LDH) was reported to be a useful parameter for the screening of periodo ntal disease. High salivary LDH levels might contribute to prevention of cardiovascular disease, through measuring systemic inflammatory burdens as well as traditional cardiovascular risk factors. Salivary LDH appears to be a promising biomarker for the mass screening of periodontitis in local community health settings. C-reactive protein (CRP) is a plasma protein that reflects a measure of the acute phase response to inflammation and is one of the markers of choice in monitoring this response. CRP participates in the systemic response to inflammation. It is a pattern recognition molecule that binds to specific molecules that are produced during cell death or found on the surfaces of diverse bacterial pathogens. Circulating C-reactive protein (CRP) levels are a marker of systemic inflammation and are associated with periodontal disease, a chronic bacterial infection associated with elevation of proinflammatory cytokines and prostaglandins[7]. Periodontal disease has many similar risk factors as CRP and IL-6, like age, body mass index, gender, and smoking status, which increases the complexity in fully accepting their association[8]. It has been postulated that a chronic infection of oral cavity may cause an entry of bacteria into the blood, thus activating the host immune response, leading to promotion of formation of atheroma, maturation, and exacerbation[9].Various periodontal biomarkers could be identified in saliva, serum, or GCF. Among the different resources available for getting biomarkers, saliva is found to be a significant biological substance. It consists of biomarkers being secreted from gingival crevicular fluid, serum, and mucosal transudate. These biomarkers are helpful in identifying and detailing the pathogenesis of various systemic disorders, including periodontal disease. The biomarkers are being used as a diagnostic tool while diagnostic dental examinations and it could be helpful in diagnosing the periodontal diseases at early stages. Furthermore, screening of the periodontal disease in large populations by the way of biomarkers could be managed more fast and easily as compared to the conventional methods available for the periodontal diagnosis. Therefore, during recent years, detection of biomarkers for diagnosing the periodontal disease has gained more attention.

Role of CRP in periodontal disease

CRP is a pentameric plasma protein having homologs in both vertebrates and invertebrates participating in the systemic reaction to the inflammation. It is a pattern identification molecule which is highly sensitive and non-specific acute-phase marker for inflammation, being produced in reply to various forms of injury besides binding to particular molecular configurations that are exposed during cell death typically or present on the surfaces of pathogens[10]. It is being regulated by various cytokines such as interleukin-1β (IL-1β), interleukin-6 (IL- 6), and

tumour necrosis factor-α (TNF-α)[11]. These leads to various systemic changes that include hepatic discharge of a variety of plasma proteins, commencement of complement proteins and different changes in metabolism. It is advocated that variations in cellular and molecular components of peripheral blood are seen in subjects suffering with periodontitis due to inflammatory changes in the periodontal tissues[12]. CRP and different acute phase molecules are generally seen in quite low levels in plasma, but they are elevated dramatically within 72hrs of injury to tissue or in case of infection. CRP opsonises bacteria for process of complement-binding and thus activates the complement when complexed. The normal CRP levels ranges between populations, with mean values being 1.0 to 3.0 mg/l. Using ultrasensitive methods, it is promising to identify CRP levels as low as <1.0 mg/l[13].

Role of IL-6 in periodontal disease

Interleukin (IL)-6 is a multifunctional cytokine that plays a key role in the inflammation of tissue characterized as a periodontal disease. Different lines of evidence have shown that IL-6 plays an essential role in periodontal disease. Firstly, various genetic studies have been conducted that reveal the role of IL-6 polymorphisms in its promoter region being linked with periodontitis. Secondly, studies from different laboratories reveal that IL-6 is mainly shown in periodontal tissue of patients suffering with periodontal disease and is linked to severity of periodontal disease. Thirdly, various *in vitro* studies have mentioned that IL-6 is an effective stimulator for the MMPs expression by mononuclear cells thus playing a signifucant role in destruction of periodontal tissue[14]. A recent study revealed that IL-6 is secreated by both cultured gingival fibroblasts as well as monocytes/macrophages, and LPS activated IL-6 expression in both the types of cells[14]. A study by Yamazaki et al[15]. advocated that the epithelial cells present in periodontal tissue also show IL-6. In other study, IL-6 immunostaining and hematoxylin counterstaining shows that a large quantity of cells are expressed as IL-6 in the periodontal tissues of patients suffering with both periodontal disease and diabetes[16]. Depending upon the histology, such cells include the epithelial cells, mononuclear cells and fibroblasts. As different resident cells like epithelial cells and fibroblasts and inflammatory cells like mononuclear cells in periodontal tissue show IL-6, it is considered that the quantity of IL-6 being released from periodontal tissue, mainly in the condition of periodontal infection, is quite high[16].

Role of LDH in periodontal disease

Various studies have investigated the salivary level of lactate dehydrogenase (LDH) as a tool for screening gingivitis and periodontitis among young adults. LDH is an enzyme which is present in the extracellular fluid after the breakdown of tissue. Various studies have revealed that the salivary LDH level is helpful for screening the periodontal disease[17]. In a study by Nomura et al [18], salivary LDH and the total count of Porphyromonas gingivalis and Prevotella intermedia was estimated. It was revealed that salivary LDH level is an indicator of inflammation as well as the destruction of periodontal tissue and can be used as a clinically useful marker after periodontal therapy[18]. Todorovic et al [19], assessed different salivary enzymes like LDH from patients suffering with periodontal disease before and after completion of periodontal treatment, and revealed that the enzymatic activity in saliva is helpful in diagnosing, making prognosis, and evaluating the therapeutic effects in periodontal disease. In a study by Rai et al [20]. salivary AST, ALT, and LDH levels were indicated being responsible for inflammation and destruction of periodontal tissues, and so could be used as useful markers clinically. The results of various studies revealed a higher LDH salivary levels are seen in cases of periodontitis than in subjects with normal periodontium. Thus according to these results, salivary level of LDH can be used as a biomarker of estimating periodontal destruction and for diagnosing the periodontal disease. Determining the salivary LDH levels can be used as a periodontal disease marker for estimating the periodontitis in large populations.

Role of biomarkers in causing periodontal disease in pregnant females

Pregnancy is a time in a woman's life where there are multiple physiological systemic alterations. During pregnancy, there are specific gingival alterations, such as pregnancy gingivitis characterized by proliferative, vascular and non-specific inflammation with widespread cellular inflammatory infiltration. Pyogenic granuloma, an exaggerated proliferative fibro vascular inflammatory response, can also affect gingival tissues [21-22]. It has been suggested that the presence of periodontitis during pregnancy might have a systemic influence, altering the levels of inflammatory markers such as CRP, IL-6 and TNF-α. Current studies suggest that these markers could be indicators of

Complications during pregnancy, such as preeclampsia, premature delivery and low birth weight. The relationship between periodontal disease and pregnancy, and the role of inflammatory mediators in these two processes is a current subject of discussion and controversy[21-22]. It has been reported that the highest peak of periodontal inflammation takes place during the third trimester of pregnancy[23]. Loe and Silness[24]. showed that the first clinical signs of gingivitis developed during the second month of pregnancy and continued increasing until the eighth month when they reached their highest levels. The mechanism of biological activity of perio-pathogens during pregnancy is directly related to the microbes of the cavity and their products (endo and exotoxins), which get into the circulatory system and reach the fetoplacental unit. The indirect mechanism relates to the influence of inflammatory mediators produced locally in periodontal tissues, which also reach the fetal–placental unit and the liver through the bloodstream, and increase systemic inflammation through the reaction of the acute phase protein, C-reactive [25]. There is an increasing amount of evidence suggesting a systemic link between maternal periodontal disease in pregnancy and adverse health consequences in offspring. Maternal periodontal disease also leads to an increase of preeclampsia and preterm births, as well as cardiovascular disease, allergies, and asthma in the offspring [26-29]. Several mechanisms and pathological pathways have been linking periodontitis with these disorders. Among them, there are short-term and long-term effects. The short-term consequences of maternal periodontitis include smaller fetuses, fetal loss, preterm delivery, preeclampsia, and small for gestation aged infants. However, this parameter could be the first sight of long term effects, as the low birth weight may be associated with an increased incidence of adult-onset cardiovascular and metabolic diseases, such as hypertension, coronary heart disease, obesity, and type 2 diabetes, as well as greater risk of reproductive and neurological disorders in later life [26-28].

CONCLUSION

For diagnosing the oral disease, there has been a stable growing tendency during the past 20 yrs to investigate and develop tools for diagnosing periodontitis. Ranging from the physical measurement methods like periodontal probing to more technically advanced methods like genetic susceptibility analysis and molecular assays for detecting the biomarkers on the different disease stages, considerable improvements have been attempted on the understanding of the mediators responsible for both initiating and progression of periodontal diseases. This evolutionary process has sparked the advent of new biomarkers and help in developing newer therapeutic methods especially using host modulation. Various new diagnostic technologies like nucleic acid and protein microarrays and micro fluidics are under progress for assessing the risk and helps in the comprehensive identification of biomarkers. These recent advancements progress to develop more advanced and powerful diagnostic tools for clinicians to optimize their predictability of treatment.

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RESEARCH ARTICLE

Antimicrobial Activity and GC-MS Analysis of *Ocimum basilicum* (Leaf) and *Curcuma longa* (Rhizome) Extracts

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ABSTRACT

The study was conducted in Coimbatore, Tamilnadu. In this study an attempt was made to control *Disonycha xanthomelas* using *Ocimum basilicum* (leaf) and *Curcuma longa* (rhizome) solvent extracts. The study was conducted to compare antimicrobial activity of leaf of *Ocimum basilicum* and rhizome of *Curcuma longa* different solvent against few human pathogens of 6 Gram-negative and 2 Gram-positive. In petroleum ether and methanol leaf extracts of *Ocimum basilicum*, *Micrococcus luteus* shows minimum zone of inhibition (0.00±0.00) and Maximum zone of inhibition showed in *Proteus mirabilis* (0.77±0.08). In petroleum ether extract of Curcuma longa rhizome showed maximum zone of inhibition is observed in *E. coli* and minimum zone of inhibition observed in both *Klebsiella* and *Micrococcus luteus*. The GC-MS analysis of petroleum ether and methanol leaf extracts of *Ocimum basilicum* identified 16 constituents. The presence of 6 constituents is identified in petroleum ether and methanol extract of *Curcuma longa* rhizome.

Keywords: Antibacterial activity, GC-MS, *Ocimum basilicum*, *Curcuma longa*,

INTRODUCTION

The earliest peoples believed that aromatic plant are only the solutions to cure some diseases. Most of the drugs are free for side effects and responses. Medicinal plants are considered a rich source of ingredients used in drug development, pharmacological, non-pharmacological or synthetic drugs. These plants play a serious role in the development of human cultures around the world. Some plants are considered as an important source of nutrition

and they are suggested for their therapeutic values. In present project work, plant extracts such as *Ocimum basilicum* (tulasi) and *Curcuma longa* (turmeric) have been tested for their antimicrobial and GC-MS analysis against *Disonycha xanthomelas (Spinach Flea beetles).*

MATERIALS AND METHODS

Preparation of extracts and fractionation

Extracts of different samples were prepared according to methods developed by Wagner H et al., Khandelwal KR. and Mukherjee PK.Step by step extraction using different solvents according to polarity was used for fractionation and direct extractions of different samples with different solvents were carried out to find yield difference of contents.

Extraction using Soxhlet apparatus

The solvents used for the extraction procedure were Acetone, chloroform, ethanol, hexane, methanol, petroleum ether. About 50gm of dried plant powder of each sample was extracted with 250 ml of the extraction solvent using Soxhlet apparatus. The extracts were concentrated to dryness to yield crude residue. The extracts were autoclaved, labelled and stored at 4°c in air tight bottles. These residues were used for Phytochemical, anti-microbial activity against tested organisms, anti-oxidant activity and for other tests. Best yield of residue was obtained in methanol hence for fractionation methanolic extracts was used. For anti-oxidant activity the shade dried coarse powder of the basil leaf and rhizome of Turmeric was extracted using methanol and petroleum ether.

Collection of microorganisms

The eight bacterial species used in the present study were the clinical isolates obtained from P.S.G. Medical College and Research Institute, Coimbatore. The bacteria used were Proteus mirabilis, Klebsiella, Salmonella paratyphi b, Escherichia coli, Serratia species, Pseudomonas aeruginosa-Gram-Negative and Staphylococcus aureus, Micrococcus luteus-Gram -Positive.

Antimicrobial Activity Testing

This includes *Proteus mirabulus*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Salmonella paratyphi* B, *E. coli*, *Serratia species*, *Micrococcus luteus*. These species were originally isolated from clinical samples and identified by standard biochemical reactions.

Media:

Nutrient broth (Hi Media M002) contain peptic digest of animal tissue (5g/L), yeast extract (1.50g/L), Beef extract (1.5g/L) was used for the growth of bacterial cultures. Antibiotic assay media No:11 (Hi Media MM004) congaing peptic digest of animal tissue (6g/L), Casein enzyme hydrolyte (4g/L), Yeast extract (1.50g/L), Dextrose (1.00g/L), Agar (15.00g/L) was used for anti-bacterial activity.

Agar well diffusion method:

The antibacterial activity of various extract of turmeric and *Ocimum basilicum* was determined by using agar well diffusion technique. For this 25 ml of sterile Muller-Hinton agar No.2 (Hi Media), was poured in sterile autoclaved Petri plates, before pouring 100µl activated bacterial culture was added, and then allowed to stand for solidification completely. The well was prepared with the help of sterile 6mm diameter cork-borer. Then 100µl of prepared crude extract (60mg/ml) solution were poured in to the wells. Then the plates were sealed with plasticize and transferred to refrigerator to diffuse out of 30 min. the plates were then incubated at 37oC for 24 hrs. Triplicate plates were prepared for each treatment and the average zone of inhibition excluding well, were recorded. 0.08mg/mL Streptomycin was used as positive control. Inoculum turbidity was maintained constant throughout the experiment to 0.8 OD at 660nm. Level of turbidity is equivalent to approximately 1X10-8CFU/ml. Determination of Minimum Inhibitory Concentration (MIC): The minimum inhibitory concentration (MIC) was determined through the broth

dilution method. Bacteria were grown in Muller Hinton broth for 6 hrs. After this, 20µl of 106cells/mL were inoculated in tubes with Muller Hinton broth supplemented with 4 different concentrations (60, 40, 20, 10 and 5 µl) of the various extracts. After 24 h incubation at 37ºC the MIC of each sample was measured through optical density in the spectrophotometer at 660nm, though the non-inoculated Muller Hinton broth Statistical analysis: Results are expressed as Mean ± SD. The statistical analysis was carried out using one-way ANOVA analysis. The p-value of 0.05 or less was considered significant for all experiment.

GAS CHROMATOGRAPHY – MASS SPECTROMETRY ANALYSIS

Collection and preparation of plant

Leaf of the *O. basilicum* and rhizome of the *C. longa*, were collected from Kozhikode and Kannur district, Kerala, India. It was kept dried out in shade and later powdered by using a mechanical grinder. The powder was passed through a sieve and stored in a labelled airtight container for further studies. The material powder of the plants was exposed to Soxhlet extraction by using petroleum ether and methanol solvent for about 24 hours. This solvent extract was evaporated to dryness.

Gas Chromatography – Mass Spectrum (GC – MS) analysis

The GC-MS analysis of the *O. basilicum* leaf and *C. longa* rhizome extract was made in an Agilent 7890 A instrument under computer control at 70 eV. About 1 µl of the petroleum ether and methanol extract was injected into the GC-MS using a micro syringe and the scanning was done for 45 min. As the compounds were separated, they eluted from the column and entered a detector which was capable of creating an electronic signal whenever a compound was detected. The greater the concentration in the sample, bigger was the signal obtained which was then processed by a computer. The time from when the injection was made (Initial time) to when elution occurred is referred to as the retention time (RT). The M/Z (mass/charge) ratio obtained was calibrated from the graph obtained, which was called as the mass spectrum graph which is the fingerprint of a molecule. Before analysing the extract using gas chromatography and mass spectroscopy, the temperature of the oven, the flow rate of the gas used and the electron gun were programmed initially. The temperature of the oven was maintained at 100°C. Helium gas was used as a carrier as well as an eluent. The flow rate of helium was set to I ml/min. The identity of the components in the extracts was assigned by the comparison of their retention indices and mass spectra fragmentation patterns with those stored on the computer library and also with published literatures. Compounds were identified by comparing their spectra to those of the Wiley and NIST/EPA/NIH mass spectral libraries (Yang *et al*., 2010).

RESULT AND DISCUSSION

The petroleum ether and methanol leaf extracts of *O.basilicum* and rhizome extracts of *C.longa* showed good inhibitory effect on the tested Gram – positive and Gram – negative human pathogens. The antibacterial activity was done at 60 µl concentration in all crude extracts from both *O.basilicum* and *C.longa* using two solvents. The extracts taken for the study were 100% concentration. The standard antibiotic used were amoxicillin. Various works in the antibacterial potency of the leaf and rhizome extracts were explored by many researchers. The present study was done to compare the antibacterial activity of leaf *O.basilicum* and rhizome of *C.longa* different solvents against few human pathogens of 6 Gram- negative and 2 Gram- positive. Extracts of leaf and rhizome were tested for antimicrobial potential showed varying degree of antibacterial activities against 8 selected pathogens. Methanolic and Petroleum ether extract of *O.basilicum* showed significant activity against most of the selected bacteria. Antibacterial

activities of petroleum ether and methanolic extracts were compared with "amoxicillin" a standard antibiotic. The methanol and petroleum ether extracts of *O. basilicum* and *C. longa* at concentration 60 have been reported to be active against several Gram-positive and Gram- negative bacteria. In petroleum ether leaf extracts of *O.basilicum,* the selected pathogens showed varied zone of inhibition. The zone of inhibition observed in *Proteus mirabilis* were 0.77 ± 0.06 mm, *Staphylococcus aureus* 0.57 ± 0.47 mm, *Klebsiella* 0.62 ± 0.09 mm, *Salmonella paratyphi b* 0.44 ± 0.04 mm, *E. coli* 0.47± 0.04 mm, *Serratia marcescens* 0.37 ± 0.04 mm, *Pseudomonas aeruginosa* 0.42 ± 0.06 mm and no zone of inhibition observed in *Micrococcus luteus* when compared to control.

The maximum zone of inhibition was observed in *Proteus mirabilis* and minimum zone of inhibition were observed in *Micrococcus luteus* (Table 1). Methanolic leaf extracts of *O.basilicum* the zone of inhibition observed against *Proteus mirabilis* was 0.77 ± 0.08 mm, *Streptococcus aureus* was 0.67 ± 0.08 mm, no zone of inhibition observed in *Klebsiella, Salmonella paratyphi b* was 0.51 ± 0.04 mm, *E. Coli* was 0.67 ± 0.47 mm, *Serratia marcescens* was 0.41 ± 0.04 mm, *Pseudomonas aeruginosa* was 0.65 ± 0.06 mm and there is no zone of inhibition observed in *Micrococcus luteus*. The maximum zone of inhibition was observed in *Proteus mirabilis* and minimum zone of inhibition were observed in *Micrococcus luteus*. There is no zone of inhibition observed when compared to control. (Table 2).In petroleum ether rhizome extract of *C.longa* were observed minimum zone of inhibition among the selected bacteria were *Proteus mirabilis*, which showed a zone of inhibition of 0.75 ± 0.08 mm, 0.71 ± 0.04 mm *Streptococcus aureus*, 0.72 ± 0.06 mm *Salmonella paratyphy b*, 0.85 ±0.09 mm *E. coli*, 0.07 ± 0.04 mm *Serratiamarcescens*, 0.83 ± 0.04 mm *Pseudomonas aeruginosa*, when compared to control. No zone of inhibition was observed were in *Klebsiella* and *Micrococcus luteus*. The maximum zone of inhibition was observed in *E. Coli* and minimum zone of inhibition were observed in both *Klebsiella* and *Micrococcus luteus*(Table 3). When compared to control, methanol extract of *C. longa* rhizome noted the minimum zone of inhibition against selected bacteria were *in Proteus mirabilis, Staphylococcus aureus, Klebsiella, Salmonella paratyphi b, E. Coli, Serratiamarcesens, Pseudomonas aeruginosa, Micrococcus luteus* are 0.80 ± 0.04 mm, 0.71 ± 0.04 mm, 0.97 ± 0.25 mm, 1.05 ± 0.05 mm, 0.82 ± 0.04 mm, 0.70 ± 0.04 mm, and no zone of inhibition observed in *Micrococcus luteus*. The maximum zone of inhibition was observed in *E. Coli* and minimum zone of inhibition were observed in *Micrococcus luteus*(Table 4).

The methanolic extract of *Ocimum basilicum* has anticancer effect by inhibition of nitric oxide synthesis(Kim *et al*., 1998). The use of medicinal plants acts as a source of antimicrobial agent also for aquaculture. In *Macrognathus pancalus*, the extract of *O. basilicum* was found to enhance the antibody response (Dugenic *et al*., 2003). The different leaf extracts of Tulsi, shows antimicrobial activity against three human pathogens *E. Coli, Staphylococcus aureus*, and *Candida albicans*, (Subrahmanian *et al*., 2014). Alcoholic extract increased step-down latency and acetyl cholinesterase inhibition and so used in the treatment of cognitive disorders. *Ocimum basilicum* has been widely employed in traditional medicines. Hence phytochemicals from this plant can be used in variety of disorders afflicting mankind. The herbs are cheap, available in large quantity around us and they pose no danger to the living organisms, the environment and the consumers and hence greatly helpful for living organisms. The turmeric natural dye possessed activity against eight different bacterial strains. The natural dye powder was active against *E. coli* and *Vibrio cholera*. (Chandran, *et al*., (2005) who studied antimicrobial activity of turmeric reported that it was effective against *E. coli*, *B. subtilis* and *S. aureus* and suggested that the activity is due to the presence of curcuminoid, a phenolic compound. The antimicrobial property of turmeric has been attributed to the presence of essential oil, an alkaloid, curcumin and othercurcuminoids, turmeric oil, turmerol and valeric acid (Cikrikci, *et al*., 2008). Phytochemical analysis of *C.longa* extract showing antimicrobial activity revealed the presence of different active constituents in different extracts *C. longa* extract contained alkaloids, tannin, flavonoid, glycoside and carbohydrate. There are report s showing that alkaloids and flavonoids are the responsible compounds for the antibacterial activities in higher plants. Antimicrobial susceptibility tests of different fractions of *C.longa* rhizome extract against *S. aureus* ATCC6571 and clinical isolates show that all fractions of *C. longa* rhizome are highly active against standard and clinical isolatesof *S. aureus* showing zone of inhibition ranges between 9 mm and 21 mm which was similar to the studyof (Negi *et al*. (1999) who reported the inhibitory effects of Methanol and hexane extract of turmeric against *S. aureus*. Further observations revealed that benzene extract was least active showing zone of inhibition of about 9 mm at the

concentration of 50 mg/ml while methanol extract was most active showing zone of inhibition of about 19 mm at the concentration of 50 mg/ml. While inhibitory activity of all other fractions ranges between the two. Similar observations have been reported for species such as *C. longa*, *Curcuma zedoaries*, *Curcuma aromatic* and *Curcuma amada* from the study. The minimum inhibitory concentration (MIC) was studied for different fractions (100 mg/mli.e., 2500mg/disc) at 1/10 (250mg/disc) and 1/100 (25mg/disc) dilutions respectively and results are compared with standard antibiotics as percentage.

GC-MS ANALYSIS

Gas chromatography-mass spectrometry analysis GC-MS is one of the best methods to identify the bioactive compounds of non-polar components and volatile essential oil, fatty acids, and lipids. Analysis was used to identify the most prevailing volatile compounds present in *O. basilicum* leaf and *C. longa* rhizome extracts. The outcome clearly depicts medicinal the existence of numerous constituents which are accountable for the medicinal activity. The explored phytocompounds was established based on the molecular peak molecular weight, molecular formula, and retention time and structure and peak area percentage. Among compounds identified by GC-MS, screening was assessed for their biological properties using physical and chemical property calculations according to Tice Rules (Senthil Kumar *etal*., 2014). As per Tice rule, if molecular weight is within ≥ 150 and ≤500; Theoretical logarithm of the noctanol / water partition co-efficient (109 P) is less than or equal to 5.0, hydrogen bond acceptor is within 1-8, hydrogen bond donor is less than or equal to 12 then compounds are considered as antimicrobial, anti-cancerous, anti-insect, antifeedant, and anti-oxidant potential compounds for novel drugs.

GC-MS Analysis of Petroleum ether leaf extract of *O. basilicum*

The GC-MS analysis of Petroleum ether rhizome extract of *O. basilicum* enabled the identification of 16 components. The extract consists of a mixture of different classes of compounds. The mass spectrum was compared with WILEY, MAINLIB, TUTORIAL and REPLIB spectral library. The constituent were present to be,1,3,4-Eugenol(13.76%),Tetradecane(4.39%), 3,4-Dimethoxyallylbenzene(37.67%), Caryophyllene (2.00%), Acetonanil (9.29%), Pentadecane(5.12%), Butylated Hydroxytoluene (8.01%), Hexanemethanol,4-Ethenyl-, Alpha-,Alpha.,4-Trimethyl-3 (1-Methylethenyl)-, [1R (.Alpha.,3.Alpha., 4(4.18%), Hexadecane (4.80%) , Heptadecane (2.44%), Nonadecane (1.52%) , Eicosane (1.44%), Heneicosane (1.20%), Nonadecyl acetate (1.07%), Phytol acetate (1.48%), and Squalene(1.64%), along with other minor constituents which is also being reported in the chromatogram. Compounds in petroleum ether extract of *C. longa* were identified by GC-MS analysis on the basis of retention time (RT). The presence of fatty acids, Methyl acetates in this have some antibacterial, antiviral, antifungal, anticancer, anti-inflammatory and antioxidant properties, it has long been used in various areas, such as cosmetology, medicine, and pharmacology (Table 5).

GC-MS Analysis of Methanol leaf extract of *O. basilicum*

The GC-MS analysis of the methanolic leaf extract of the *O.basilicum* enabled the identification of of 12 components and enabled. The principle chemical constituents were found to be p-Vinyl guaiacol (3.48%), Eugenol (39.71%), 3,4-Dimethoxyalllylbenzene (38.90%), Elemol (1.97%), Ar-tumerone (1.88%), Curlone (1.08%), Loliolidae (1.21%), Methyl palmitate (1.14%), 9-Octadecenoic acid (z)-, Methyl ester (4.01%), Methyl stearate (5.46%), Erucic acid methyl ester (0.78%), and Methyl Lignocerate (0.39%). compounds were identified by GC-MS analysis on the basis of retention time (RT), Fragmentation patterns and data comparison with WILEY, MAINLIB, TUTORIAL and REPLIB spectral library which give complete structure identification. Constituents possess significant anticancer activities, affecting growth andproliferation of numerous cancer cells (Table 6).

GC-MS Analysis of Petroleum ether rhizome extract of *C. longa*

Various major and minor constituents identified in the petroleum ether rhizome extract of *C.longa*. Total major 6 components were identified. The principle chemical constituents were found to be Alpha-curcumin (0.68%), Zingiberene (1.01%), Beta-Sesquiphellandrene (1.42%), Turmerone (69.57%), Curlone (27.69%), and Spiro [bicyclo [3.3.0] octan-6-one-3-cyclopropane] (2.63%) with other minor constituents which is also being reported in the Chromatogram. Compounds in petroleum ether rhizome extract of *C.longa* were identified by GC-MS analysis on the

basis of retention time (RT), Fragmentation patterns and data comparison with WILEY, MAINLIB, TUTORIAL and REPLIB spectral library which give complete structure identification. The presence of fatty acids, Methyl acetates in this have some antiviral, insecticidal and fungicidal activities. So, the chemical constituents present in *C. longa* rhizome play major role in the biological activities (Table 7).

GC-MS Analysis of Methanol rhizome extract of *C.longa*

Total major 6 components were identified. The principle chemical constituents were found to be Alpha-curcumin (0.78%), Zingiberene (0.86%), Beta-Sesquiphellandrene (1.48%), Turmerone (69.69%), Curlone (25.49%), and Spiro [bicyclo [3.3.0] octan-6-one-3-cyclopropane] (1.70%) with other minor constituents which is also being reported in the Chromatogram. Compounds in methanol rhizome extract of *C. longa* were identified by GC-MS analysis on the basis of retention time (RT), Fragmentation patterns and data comparison with WILEY, MAINLIB, TUTORIAL and REPLIB spectral library which give complete structure identification. The presence of fatty acids, Methyl acetates in this have some antiviral, insecticidal and fungicidal activities. So, the chemical constituents present in *C. longa* rhizome play major role in the biological activities (Table 8). GC-MS chromatogram of the methanolic extract of *Ocimum basilicum* showed four major components and has been identified after comparison of the mass spectra. It was observed that presence of Eugenol(Synonym: 2-Methoxy -4-(2-propenyl)phenol), 1,2,4-triethenyl were the major component in the extract. The phytochemicals that contribute to the medicinal property of the plant leaves. Eugenol is reported to possess antimycotic (Azzous *et al*., 1982) Antiviral(Bishop, 1995) Desinsection (Konstantopoulou *et al*., 1992) Antiparasitic (Pandey et al., 2011) Antioxidant (Ou *et al*., 2006)Anticancer (Hussain et al., 2011) and Anti insect activities (Pessoa *et al*., 200). The chemical constituents of *C. longa* extract were determined and identified by GC-MS. It showschemical constituents of turmeric extract, and, and their retention time and Covets indices. The dataindicated the presence of five compounds in turmeric extract. Aromatic turmerone (21.4%), a-zingiberene(15%), ß-(Z)- farnesene (13.96%), aromatic curcumene (10.3%), turmerone (6.2%) and curlone (5.1%)were found to be the major com pounds in turmeric extract. Aromatic turmerone has been implicated in many biological activities (Baik *et al*., 1993; Ferreira et al.,1992; W halon et al., 1998; Helen et al., 1982; Roth et al., 1998). Probably aromatic turmerone alone orin synergy with turmerone, curlone and com pounds (6 -9) is responsible for the higher antifungal activity. The essential components identified from the leaves of sweet basil are A total of 15 compounds representing 94.67% of sweet basil oil were identified. Estragole (38.226%), 1-isopropyl-4- methylenecyclohex-1-ene (I1.104%), 2-propenoic acid-3-phenyl-methyl ester ((E)-methyl cinnamate) (6.510%), p-mentha-1(7), 8-diene (6.012%), L-Fenchone (5.793%). a-caryophyllene (4.569%), eucalyptol (3.462%), a-pinene (3.813%), a-cubebin (2.474%), isocaryophyllene (2.460%), methyl-2-phenyl-prop-2-enolate (1.887%), eugenol (1.531%), eudesma-3,7(11)-diene (3.164%), beta-bisabolene (2.395%), and trans-a-bergamotene (1.268%) were found as the major compounds. According to the GC-MS display, nine monoterpenes (eucalyptol, L-Fenchone. 1-isopropyl 4-methylenecyclohex-I-ene. a-pinene. estragole. p-mentha- I(7).8-diene, methyl-2-phenyl-prop-2-enolate, eugenol, and (E)-methyl cinnamate) and six sesquiterpenes (isocaryophillene, trans-a-bergamottin. eudesma-3.7(11)-diene, o-cubebin, beta-bisabolene, and a-caryophyllene) were identified in the essential oil. The results of this study are also in a good agreement to those of (Telci *et al*., 2006)who reported the oxygenated monoterpenes as the major compounds in Turkish *O. basilicum* essential oil. According to:(Ozcan and Chalchat 2002),the main compounds of oil from basil herb collected in Turkey were eugenol (78.02%), a-cubebin (6.17%) which were also reported in this research as the components of the essential oil of the leaves of *O. basilicum*. Estragole, which hold the highest composition of the essential oil in this research was also reported as the major component of the oil, extracted from the leaves of Ocimum species. a-cubebin, a-caryophyllene, and L-Fenchone were also identified in the areal parts of *O. basilicum*
Abdullah Ijaz Hussain (2009).

CONCLUSION

The selected plant extracts possessed antibacterial activity against tested gram-negative bacteria, the variation in the zone of inhibition suggesting that the varying degree of efficacy of different Phyto-constituents of herb on the target organism. The antibacterial activity of the plants may be due to the presence of various bioactive compounds in their

leaves. Further studies are need to isolate and characterize the bioactive compounds to develop new antibacterial drugs. It has been traditionally believed that natural dyes with yellow color like turmeric show an antimicrobial effect against feeding damage by the larvae. It is clarified that many natural dyes show antimicrobial effects against various pests and beetles. The final goals of the present paper describe that certain compound present in the selected plant act as antimicrobe. Hence in this paper an attempt was tried with botanical in controlling microbes. further investigations can be made to find out the potential effects of a particular compound which may control the pathogens.

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Table 1: Zone of inhibition formed by different bacteria in Petroleum Ether leaf extract of O. basilicum at 60µl concentration

Sl.No	Bacterial Name	Zone Of Inhibition (mm)	Amoxicillin (Control)
1	*Proteus mirabilis*	0.75 ± 0.06	12.00 ± 0.50
2	*Staphylococcus aureus*	0.57 ± 0.47	28.20 ± 1.10
3	*Klebsiella*	0.62 ± 0.09	25.00 ± 1.81
4	*Salmonella paratyphi b*	0.44 ± 0.04	17.28 ± 5.76
5	*E. coli*	0.47 ± 0.04	21.40 ± 0.81
6	*Serratia marcescens*	0.37 ± 0.04	12.50 ± 0.91
7	*Pseudomonas aeruginosa*	0.42 ± 0.06	25.00 ± 1.88
8	*Micrococcus luteus*	0.00 ± 0.00	16.00 ± 2.71

Table 2: Zone of inhibition formed by different bacteria in Methanol leaf extract of *O. basilicum* at 60µl concentration

Sl.No	Bacterial Name	Zone Of Inhibition (mm)	Amoxicillin (Control)
1	*Proteus mirabilis*	0.77 ± 0.08	12.00 ± 0.50
2	*Staphylococcus aureus*	0.67 ± 0.08	28.20 ± 1.10
3	*Klebsiella*	0.00 ± 0.00	25.00 ± 1.81
4	*Salmonella paratyphi b*	0.51 ± 0.04	17.28 ± 5.76
5	*E. coli*	0.67 ± 0.47	21.40 ± 0.81
6	*Serratia marcescens*	0.41 ± 0.04	12.50 ± 0.91
7	*Pseudomonas aeruginosa*	0.65 ± 0.06	25.00 ± 1.88
8	*Micrococcus luteus*	0.00 ± 0.00	16.00 ± 2.71

Table 3: Zone of inhibition formed by different bacteria in Petroleum Etherrhizome extract of *C. longa*at 60µl concentration

Sl.No	Bacterial Name	Zone Of Inhibition (mm)	Amoxicillin (Control)
1	*Proteus mirabilis*	0.75 ± 0.08	12.00 ± 0.50
2	*Staphylococcus aureus*	0.75 ± 0.04	28.20 ± 1.10
3	*Klebsiella*	0.00 ± 0.00	25.00 ± 1.81
4	*Salmonella paratyphi b*	0.72 ± 0.06	17.28 ± 5.76
5	*E. coli*	0.85 ± 0.09	21.40 ± 0.81
6	*Serratia marcescens*	0.72 ± 0.04	12.50 ± 0.91
7	*Pseudomonas aeruginosa*	0.83 ± 0.04	25.00 ± 1.88
8	*Micrococcus luteus*	0.00 ± 0.00	16.00 ± 2.71

Table 4: Zone of inhibition formed by different bacteria in Methanolrhizome extract of *C. longa*at 60µl concentration

Sl.No	Bacterial Name	Zone Of Inhibition (mm)	Amoxicillin (Control)
1	*Proteus mirabilis*	0.85 ± 0.04	12.00 ± 0.50
2	*Staphylococcus aureus*	0.73 ± 0.04	28.20 ± 1.10
3	*Klebsiella*	0.00 ± 0.00	25.00 ± 1.81
4	*Salmonella paratyphi b*	0.97 ± 0.25	17.28 ± 5.76
5	*E. coli*	1.05 ± 0.05	21.40 ± 0.81
6	*Serratia marcescens*	0.82 ± 0.04	12.50 ± 0.91
7	*Pseudomonas aeruginosa*	0.74 ± 0.04	25.00 ± 1.88
8	*Micrococcus luteus*	0.00 ± 0.00	16.00 ± 2.71

Table 5: GC-MS analysis of Petroleum ether extracts of *O. basilicum*

Sl. No	R.Time	Name	M.F	M.W	HBD	HBA	RBC	XLogP3	Area %
1	11.959	1,3,4-Eugenol	$C_{10}H_{12}O_2$	164.20	1	2	3	2	13.76
2	12.725	Tetradecane	$C_{14}H_{30}$	198.39	0	0	11	7.2	4.39
3	13.006	3,4-Dimethoxyallybenzene	$C_{10}H_{12}O_2$	164.20	0	2	3	2.3	37.67
4	13.480	Caryophyllene	$C_{15}H_{24}$	204.35	0	0	0	4.4	2.00
5	14.076	Acetonanil	$C_{12}H_{12}N$	173.25	1	1	0	2.8	9.29
6	15.129	Pentadecane	$C_{15}H_{32}$	212.41	0	0	12	7.7	5.12
7	15.606	Butylated Hydroxytoluene	$C_{15}H_{24}O$	220.35	1	1	2	5.3	8.01
8	16.541	Hexanemethanol,4-Ethenyl-, Alpha-,Alpha.,4-Trimethyl-3(1-Methylethenyl)-,[1R(.Alpha.,3.Alpha.,4	$C_7H_{18}O$	118.22	1	1	3	0	4.18
9	17.448	Hexadecane	$C_{16}H_{34}$	226.44	0	0	13	8.3	4.80
10	19.674	Heptadecane	$C_{17}H_{36}$	240.05	0	0	14	8.8	2.44
11	21.803	Nonadecane	$C_{19}H_{40}$	268.5	0	0	16	9.9	1.52
12	25.781	Eicosane	$C_{20}H_{42}$	282.5	0	0	17	10.40	1.44
13	27.635	Heneicosane	$C_{21}H_{44}$	296.6	0	0	18	11	1.20
14	29.635	Nonadecacyl acetate	$C_{21}H_{42}O_2$	326.6	0	2	19	9.4	1.07
15	29.814	Phytol,acetate	$C_{22}H_{42}0_2$	338.6	0	2	15	8.8	1.48
16	39.221	Squalene	$C_{30}H_{50}$	410.7	0	0		11.6	1.64

Table 6: **GC-MS analysis of the methanol leaf extract of *O. basilicum***

Sl. No	R.Time	Name	M.F	M.W	HBD	HBA	RBC	XLogP3	Area%
1	14.490	p-Vinylguaiacol	$C_9H_{10}O_2$	150.17	1	2	2	2.4	3.48
2	15.599	EugenCol	$C_{10}H_{12}O_2$	164.20	1	2	3	2	39.71
3	16.778	3,4-Dimethoxyallylbenzene	$C_{10}H_{12}O_2$	164.20	0	2	3	2.3	38.90
4	20.439	Elemol	$C_{15}H_{26}O$	222.37	1	1	3	4.4	1.97
5	23.090	Ar – tumerone	$C_{15}H_{20}O$	216.32	0	1	4	4	1.88
6	23.911	Curlone	$C_{15}H_{22}O$	218.33	0	1	4	4	1.08
7	25.552	Loliolidae	$C_{11}H_{16}O_3$	196.24	1	3	0	1	1.21
8	28.397	Methylpalmitate	$C_{17}H_{34}O_2$	270.5	0	2	15	7.9	1.14
9	31.727	9-Octadecenoic acid (Z)-,Methyl ester	$C_{18}H_{34}O_2$	282.5	1	2	15	6.5	4.01
10	32.187	Methyl stearate	$C_{19}H_{38}O_2$	298.5	0	2	17	9	5.46
11	38.487	Eruic acid methyl ester	$C_{23}H_{44}O_2$	352.6	0	2	20	9.8	0.78
12	41.835	Methyl lignocerate	$C_{25}H_{50}O_2$	382.66	0	2	23	12.3	0.39

Table 7: GC-MS analysis of Petroleum ether rhizome extract of *C. longa*

Sl. No	R.Time	Name	M.F	M.W	HBD	HBA	RBC	XLogP3	Area%
1	14.882	Alpha-Curcumene	$C_{15}H_{22}$	202.33	0	0	4	5.4	0.68
2	15.172	Zingiberene	$C_{15}H_{24}$	204.35	0	0	4	5.2	1.01
3	15.866	Beta-Sesquiphelliandrene	$C_{15}H_{24}$	204.35	0	0	4	5.4	1.42
4	19.259	Tumerone	$C_{15}H_{20}O$	216.32	0	1	4	4	66.57
5	19.978	Curlone	$C_{15}H_{20}O$	218.33	0	1	4	4	27.69
6	21.530	Spiro[bicyclo(3.3.0)Oct an-6-on-3-Cyclopropan]	$C_{10}H_{14}O$	150.22	0	1	0	2	2.63

Table 8: **GC-MS analysis of methanol rhizome extract of *C. longa***

Sl. No	R.Time	Name	M.F	M.W	HBD	HBA	RBC	XLogP3	Area%
1	18.707	Alpha-Curcumene	$C_{15}H_{22}$	202.33	0	0	4	5.4	0.78
2	19.011	Zingiberene	$C_{15}H_{24}$	204.35	0	0	4	5.2	0.86
3	19.729	Beta-Sesquiphelliandrene	$C_{15}H_{24}$	204.35	0	0	4	5.4	1.48
4	23.177	Tumerone	$C_{15}H_{20}O$	216.32	0	1	4	4	69.69
5	23.913	Curlone	$C_{15}H_{20}O$	218.33	0	1	4	4	25.49
6	25.499	Spiro[bicyclo(3.3.0)Oct an-6-on-3-Cyclopropan]	$C_{10}H_{14}O$	150.22	0	1	0	2	1.70

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RESEARCH ARTICLE

Quantitative Study on Ethnomedicinal Plants used by the Different Tribal People of Jhargram District, West Bengal, India

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ABSTRACT

The tribal people of remote areas of Jhargram District mainly depend on traditional medicinal system for cure various ailments. The present study highlights documentation of ethnomedicinal information in different areas of Jhargram District. The extensive field survey was carried out from January 2019 to February, 2020. A total of 84 informants were selected from different village areas of Jhargram District for collecting ethnomedicinal information through questionnaires, conversation, group discussion, interviews and cross interviews in different villages among different communities. The informants provide information about 68 ethnomedicinal plants belonging to 34 families used for the treatments of 52 ailments such as cold, cough, asthma, cut, wounds, dysentery, diarrhea etc. and also record the local tribal name, uses, usable parts, mode of administration and combination, actual does and duration. Surveying data were analyzed following the different Quantitative tools such as RFC and FIC.

Keywords: Jhargram distric, traditional, tribal, ethnomedicinal plnats, ailments, quantitative tools

INTRODUCTION

Jhargram is a district in the state of West Bengal, India and it was formed on 4th April 2017. Most of the area contains lateritic and alluvial soil. The river Subarnarekha is the main stream of this district [1]. Tribal people living closely associated with nature, mainly depended their daily life. Season wise field survey was conducted on January, 2019 to February, 2020 in different village areas of Jhargram District. Present study has been carried out to documentation on various uses of medicinal plants, actual mode of utilization and mode of administration of medicine, doses and duration etc. Information was gathered through questionnaires, conversation, group discussion, interviews and cross

interviews in different villages among different communities. Present study exhibits a total of 68 plant species belonging to 64 genera and 34 families. A total 84 informants were sleeted for collecting traditional indigenous knowledge about 68 medicinal plants. Several quantitative tools were used for data analysis such as Informant Consensus Factor(Fic) and Relative Frequency of Citation (RFC) of such species and aliments. Ethnobotanical tools provide data which is suitable to the hypothesis-testing, subsequent statistical validation, and comparative analysis [2]. Whole plant, leaves, stem, stem bark, seeds, fruit, flowers, root, root bark, rhizome, bulbs are the major plant parts used for the preparation of medicine. Medicine in different forms such as decoction, pills, paste, infusion, extracts and oil etc. The main aim and objectives of the present study is to urgent need for conservation and documentation of plants and medicinal knowledge of the tribal people for future generation.

MATERIALS AND METHODS

Study area

Jhargram district is situated in south west corner of the West Bengal, lying between 22.45º North and 86.98º East longitude (Figure-1) and sharing borders with neighboring states of Jharkhand and Odisha. Total area of this district is about 3,024.38 km² and has 8 community development blocks viz. Jhargram, Binpur-I, Binpur-II, Jamboni, Gopiballavpur-I, Gopiballavpur-II, Sankrail and Nayagram. The total population of the district is 11,37,163 as per 2011 census. About of 96.52% population lives in rural area and 3.48% population lives in urban areas of Jhargram district. Out of the total population 20.11% is scheduled castes and 29.37% is scheduled tribes. The important tribal communities of this District are Santal, Munda, Lodha, Sabar and Bhumij.

Field survey, selection of informants and method of data collection:

Season wise field survey was done on January 2019 to February, 2020 in different village areas of these eight blocks. Ethnomedicinal information were collected from the main dominating tribal medicine man who have rich indigenous traditional knowledge about medicinal plant species of 5 different tribal communities like Santal, Munda, Lodha, Sabar and Bhumij for treatment of their different ailments. A total 84 informants were selected for gathering knowledge through questionnaires, conversation, group discussion, interviews and cross interviews. Audio and video recording was also done throughout all interviews. Finally the whole data was cross-checked with the help of available published literature [3-14].

Quantitative tools for ethnomedicinaldata analysis:

The standard quantitative tools are as follows:

- Relative Frequency of Citation (RFC)
- Informant Consensus Factor (FIC)

Relative Frequency of Citation (RFC)

It is an index which is obtained by division of the number of informants mentioning the use of species to the total number of informants who participated in the survey area. Less value is given to the variables like the type of use or disease category. The most popularly used plant species will get the utmost number for the citation frequency among the community members [15]. This is calculated using the following formula. Relative Frequency of Citation;

RFC = FCs / N

Where, RFC = Relative Frequency of Citation

FCs = Number of informants who mentioned the use of species

N = Total number of informants.

Theoretically, it varies from zero to 1. When few informants cite the species a value close to zero is obtained. The upper limit one is occasionally obtained, it is possible only when all the informants cite a particular species.

Informant Consensus Factor (Fic)

It was developed by Trotter and Logan which tests the consistency of informant's knowledge regarding plants species for treating a particular illness category [16]. This parameter accounts for the degree of agreement among the different informants interviewed concerning the use. Fic value also expresses the cultural contiguity of the selection of ethnomedicinal plants for curing of certain disease category. This method helps the researcher in case of lower familiarity with the community; lower subjective thereby suitable for statistical analysis. It is predicted as the number of mentions in each usage category (Nur) minus the number of taxa used in each category (Nt), divided by number of mentions in each usage category minus one.

Fic = Nur – Nt / Nur – 1

A citation of each plant is recorded separately and it is an event. Thus, the same plant and same informant may participate in many such events. A high Fic value indicates the use of relatively few species in a certain use category. Its value ranges between zero and 1. The Fic value is near to zero indicates there is no exchange of information about their use, among the informants. In case of well-defined usage information, its value reaches one. This indicates high utility of the plant species among the inhabitants of a community.

RESULT AND DISCUSSION

A total of 68 ethnomedicinal species were recorded from the 84 informants under 5 different tribal communities like Santal, Munda, Lodha, Sabar and Bhumij for treatment of their different ailments. The habit wise distribution of the species is given in Figure 2. The study represents the tribal use of 68 medicinal plants covering 64 genera and 34 families of angiosperms. It records the different ethnomedicinal uses of these plants either alone or in combination with other species. It also discusses parts-wise utility of the species. The informant Consensus Factor (Fic) of 52 diseases categories and the overall calculation is given in above Table 1. The Fic value ranges from 0.52 to 1.0. The highest Fic value is 1 of the following diseases such as arthritis, carbuncle, dehydration, nasal bleeding, contraceptives and Whitlow. The second highest Fic value, 0.98 of anemia disease followed by 0.97 in such cases like dog bite, lymph gland swelling and also hair growth, 0.96 in anthelmintic, eczema, seminal weakness, mouth and throat sore. The lowest Fic value is 0.52 for leucoderma. Heighest Fic values indicate that only one particular species used to cure a particular disease, this species has not been substituted by any other species. Low Fic value indicates that one species substituted by some other species due to unavailability. The highest no. of ethnomedicinal species were used to treat Cuts, wounds and ulcers (19 species) followed by cold, cough, whipping cough and bronchitis (15 species), then asthma (12 species). While only 1 and 2 species found to treat following diseases arthritis, carbuncle, dehydration, contraceptives, nasal bleeding and whitlow. A total of 68 species with RFC and Fic values are given in Table 2-3.

On optimizing the following data, the highest value of RFC is 1 (one) in *Achyranthes aspera* and *Aerva javanica* from Amaranthaceae family then *Andrographis paniculata*, *Hygrophila schulli* and *Justicia adhatoda* from Acanthaceae family, *Asparagus racemosus* (Asparagaceae), *Azadirachta indica* (Meliaceae), *Hemidesmus indicus* (Apocynaceae), *Ocimum sanctum* (Lamiaceae), *Terminalia chebula* (Combretaceae). *Achyranthes aspera* commonly called Chitchite (Lodha, Bhumij), Buridantram (Santali). Whole plant extract used to cure body pain and body swellings. Leaf paste extract taken orally for cure malarial fever. Leaves paste applied on forehead to cure headache. Root paste mixed with roots of Kedar (*Ochna obtuse*), Bhuikambal (*Premna herbacea*), Golmorich (*Piper nigrum*) applied to cure gout. Stem bark paste with Halud (*Curcuma longa*) to cure sores of children. Flowering spike paste with the paste of long peppers (*Piper longum*) two times a day for five days to treatment of mad dog bite. *Aerva javanica* commonly called Lal bishalyakarani (Bengali and Santali) mainly used on wounds to stop bleeding. *Andrographis paniculata* commonly called Kalmegh (Bengali); Bhui-nimb (Lodha), Kanri-buru (Santali). The plant mainly used to cure liver compliance, diabetes and skin allergy and also used for curing stomach pain, snake bite and malarial fever. *Hygrophila schulli* commonly called Kulekhara, in Santali Gokhulajanum. Whole plant used to treat anemia. Leaves juice taken to treat

anemia. Leaves paste with Long peppers (*Piper longum*) used to treat dropsy. Root paste takes orally to cure body pain. *Justicia adhatoda* common name is Basak, Basak-pati (Santali). Leaves with warm water used to relief from body pain and also used as an antiseptic. Leaves juice with honey used to cure cold, cough and asthma. Leaves paste with paste of Turmeric (*Curcuma longa*) used to cure leucoderma and skin disease. *Asparagus racemosus* commonly called Satamul, Satmuli, in Santali it is called Gai-sira. Tuberous roots paste with a mixture of Golmorich (*Piper nigrum*) Kalogira (*Nigella sativa*) Pan Mouri (*Foeniculam vulgare*) roots of Ramdatun (*Smilax ovalifolia*) made pills use to treat seminal weekness. Tuber crushed with turmeric (*Curcuma longa*) taken orally for cure chest pain, two teaspoons thrice a day for 4 days. Also used to treat stomach pain, blood dysentery, dehydration and asthma. Paste with Anantamul (*Hemidesmus indicus)* and Ramdatun (*Smilax ovalifolia*) root paste make into pills use to treat white discharge for woman. Root paste and root of Anantamul (*Hemidesmus indicus)* used to treat huge bleeding during menstrual cycle. Root paste with Anantamul (*Hemidesmus indicus*) and head parts of Tortoise with ghee made into pills used to treat piles. Root used for diabetic patient for preparation of some sweets. Root extract taken to cure sunstroke. Root decoction with Arahar leaf (*Cajanus cajan*) used for the treatment of jaundice. *Azadirachta indica* commonly called Neem, Nim, Bakom-dare (Santali). Leaf paste with paste of Seuli leaf (*Nyctanthes arbortristis)* and Kalmegh (*Andrographis paniculata*) made a pills and taken orally as a cure eczema. Leaf paste with paste of jack fruits leaf, mustered oil, Halud (*Curcuma longa)* applied on itching for 3-5 days. Fresh and dry leaf extract taken for diabetis. Leaf with warm water used to treatment of skin disease like scabies, boils and also used as washing septic wounds. Leaf extract used to treat as an anthelmintic.

Root bark decoction used to cure fever, blood complaints, inflammation. Seed oil applied on skin disease like ringworm, scabies and also used gout, rheumatism. Seed oil used as a mosquito repellent liquid. Young branch used to treatment of cold, cough, asthma. Young branch with common salt used as toothbrush for cure toothache. *Hemidesmus indicus* local name is Anantamul, Dudhinari (Santal). Root crushed with Garlic (*Allium sativum*) and the extract used for curing menstrual disorder. Root paste with Kusum (*Schleichera oleosa*) seed oil used for skin disease, leucoderma and scabies. Root paste used to cure eruption of tongue for children and leaf decoction used to cure stomach pain. *Ocimum tenuiflorum* commonly called Radha tulsi (Bengali); Tunrusi (Lodha); Bir-tulsi, Malmalgina in Santali. Root paste applied on dog biting portion cure to biting wounds. Crushed leaves with honey used to treatment of cold, cough, asthma, fever. Leaves also used for dental infection. Leaves juice used as blood purifier and also applied to cure ring worm. *Terminalia chebula* its local name is Haritaki, Rol (Santali).The plant parts fruit decoction with paste of Black Peppers (*Piper nigrum*) use to cure for dyspepsia, fruit decoction used for liver tonic and also used as hair wash for cure dandruff. Fruit decoction with paste of Black Peppers (*Piper nigrum*) and honey used to treat cold, cough and asthma. Among the 68 species based on the RFC value three broad categories were identified: small with value between 0.5 to 0.50, medium with value between 0.51 to 0.75 and large with value between 0.76 to 1 (Figure 3).This RFC value calculated depends on the collected ethnomedicinal data. The upper RFC values 1 indicate all informants inform a particular species and also their abundant use. The small RFC value 0.5 is indicating that few informants inform a particular species.

CONCLUSION

The present study highlights that, the important traditional knowledge about medicinal plants used by the tribal medicine men for cure various ailments, which were documented. Otherwise we are bound to loss our indigenous knowledge system for ever. It is essentially required to proper protection, conservation, cultivation and utilization of these ethnomedicinal plants in this district. During survey it was seen that, many important ethnomedicinal plants are becoming rare because the tribal people sale this plants and plant parts viz. root, stem, bark, fruit and seed etc. in the market and Mahajans (Business man) to gain high prices. The overexploitation of many valuable medicinal plants from nature like *Asparagus racemosus*, *Holostemma annularis*, *Hemidesmus indicus and Martynia annua* etc. shows their rare occurrences in the countryside. It is high time to aware the tribal people as well as local villagers to protect and conservation of these valuable medicinal plants, otherwise the complete loss of many valuable plants from their own habitat. The quantitative ethnomedicinal tools such as ICF and RFC were used for data analysis. The ICF value

determined that only one particular species or many other species used to cure a particular disease and RFC indicate that the abundant uses of a particular species for cure different diseases. This study recommends to initiate the sustainable utilization and to make step of protection, conservation, propagation, stop of overexploitation of many valuable medicinal plants, to save the plant genetic resources and their sustainable uses.

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REVIEW ARTICLE

Zebrafish as Animal Model for Biological and Toxicological Evaluation - A Review

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ABSTRACT

Zebrafish (*Danio rerio*) is considered as unique model of vertebrates in pharmaceutical research areas such as development of drug, disease modeling and other biological exploration. Since from 1960, Zebrafish has its own importance when it comes to scientific research. It has been used as a tool in research for advance learning of several biological concepts in genetics and developmental behavior. Remarkably they are biologically similar to *Homo sapiens* and share the majority of similar genes, which increases its importance as a model for understanding working of genes in health and diseases. On entire genome sequencing of the zebrafish, revealed that 70% of protein-coding genes are similar in both human and zebrafish. High throughput screening for potent novel therapeutic compounds with specific biological activity is possible through studies in embryos of zebrafish. In the current review we discuss the recent advancements and efforts made in different fields of biology that makes zebrafish a potent model.

Keywords: zebra fish; *Danio rerio*, Model organism, *in-vivo* toxicity, marine sources

INTRODUCTION

Danio rerio the Latin name for zebrafish formerly called *Brachydanio rerio* is a small tropical freshwater fish originating in the Ganges River and its tributaries in northern India [1]. In the natural habitat, zebrafish are usually found near the bottom of the water to minimize attack by predators. The habitat of zebrafish in tropical region is fresh water, mostly Himalayan Rivers in South Asian region of Bhutan, Myanmar, Nepal and India. It's a teleost, member of Cyprinidae family under Actinoterygii class [2]. Over the last few decades, the commission of biological

ethics has considered the research study in higher vertebrates for testing toxicity and its application was extended to herbal toxicology [3]. Zebrafish is widely used as a model organism because of its physiological and morphological similarity to mammals. For the studies on developmental biology, cancer, discovery of drug and molecular genetics the animal plays the best leading role. The presence of several genomic tools makes it easy for performing screening of drugs based on phenotype. Even though the animal studies and screening are physiologically complex, *Danio rerio* is a promising model for the development of many aspects for the development of drug, which includes the identification process, lead discovery and toxicological studies.

In recent years, the development and innovation of techniques in molecular biology has increased the usage of zebrafish throughout the world. Many characteristics of zebrafish suited itself as animal model as its fertility rate is high, development of embryo is fast outside the parental fish, the embryos are transparent in nature, allows the view and examination of its development from outside [4]. The transparent nature of the embryo facilitates in detail study of the stages of larval development and it's a huge advantage [5]. The *Danio rerio* was used for studying several complex behaviors mainly memory, sleep & wake, locomotion and depressive behaviors [6]. The excitability of neurons when pairing behavior is collaborated with direct imaging resulted in illumination of the neuronal circular activity and its response in behavior of Zebrafish. *Danio rerio* is also an important model for studying hematology of vertebrates and also has filled the gap between mammalian animals as an *in vitro* model. Recent researches have taken their characteristics such as genetic flexibility, convenient embryology and conserved biology for assistance in contributing to hematopoietic studies. The present review has elaborated the cellular and genomic nature of zebrafish that facilitates it as an excellent model organism. The review also explains the therapeutic applications of the animal and also its use in aquaculture industry.

***Danio rerio:* A transparent vertebrate**

Danio rerio is used as genetic model for human physiology, genomic studies, biomedical research, and toxicological studies. This fish is tiny in size and is a versatile model organism for research as it is easy to maintain, embryos are transparent, less price, high ability for production of offspring, genetic similarity with humans and the transparency in body during development [7]. The transparent nature of the zebra fish has a vital role in recent development in biomedicines that allows the scientist in viewing the internal organs directly and helps in observation of several processes such as metastasis of tumor and production of blood after transplantation of bone marrow [8]. The major beneficial character of zebrafish which is not seen in any other vertebrates is its transparent nature which helps the researchers in observation of the stages of development for neurobiology and is also used in studying function, toxicology and behavior of organs. Even the embryo of *Danio rerio* gives valuable information on toxicity of chemicals and discovery of lead molecules.

Growth phases and housing of *Danio rerio*

The research on *Danio rerio* is mainly focused on stages of embryo; the later stages that are the adulthood are highly examined now days. The stages of development based on age is a way examined to study on maturity, factors of environment, density of population, quality of water, the after effects of growth and maturation. The length of the fish and external morphological traits are visible markers that impacts on maturation state [9]. The morphological changes during development of embryo are visible right before and after hatching stages. The zebra fish cultured in laboratory takes three or four days for hatching after post fertilization [10]. The end of embryogenesis is the stage in which mouth protrudes. After that period, development of larvae takes place and lasts for almost six weeks, in this period the fish undergoes severe morphological changes and increases three times in length, growth of fins, change in pattern of pigments, the juvenile transformation takes place etc, on the forty fifth day after fertilization at around 28.5°C, it reaches the sexual maturity, and categorized as adults [11].

The researchers who work on zebrafish in laboratory needs only one glass aquarium on a bench or row of racks with little tanks made up of plastics [12]. It is a fresh water fish and can be sensitive towards tap water as it has chlorine and other chemicals, so chlorine need to be removed by de-chlorination or by aeration in the water container. Several research laboratories follow reverse osmosis or de-ionization of water by addition of small quantity of aquarium salt

for getting the desired salinity [13]. The approximate water temperature should be ideal that is 28.5°C, fourteen hours light and ten hours dark is the ideal photoperiod. Commercially available fish foods are used for feeding them. Many diets are available in market for them that are specific for optimization of reproduction and growth [14]. The range of feeding the fish should be between 1 to 2X per day in case of adults, so they can breed easily, a produce several fertilized egg. The fish should be fed well before breeding; mostly the time period for breeding is approximately one night before the eggs are obtained. The adult fish has the habit of cannibalization of the embryos, so a barrier must be present in between the eggs and the adults [15].

Anatomical and Genetic similarity of zebrafish to humans

On genetic sequencing of the entire genome of zebrafish, seventy percentage of protein coding genes are founded similar in both and interestingly eighty four percent of the genes in human diseases are also found similar [16]. The genome compositions of humans are approximately 98% similar to monkey, 97% rat, 91% zebrafish, 54% drosophila and 47% to Caenorhabditis elegans. They have immune system, bones, digestive, nervous and cardiovascular system. This zebra fish growing properties are compared to other organ system of humans with Alzheimer's disease, Parkinson's disease, gene characterization, cell cycle, malignancy and oncogene. The zebra fish and humans show highly similar phenotypes as both have high levels of conservation of genes both in genetic and anatomical [17]. Thus, the study of genome enhances the importance if zebrafish as an ideal model for disease study in humans, so the study of genome acts as a resource for knowing the function of gene and disease condition in people. It has already used for study of advanced stages of cancer, heart disease, and also for studies to know advancement in development of organ and muscles [18]. The vertebrate model is used for verification of casual genes that are involved in disorders such as muscular dystrophy and for evolution of multiple melanoma disease. Moreover, zebrafish have two eyes, a mouth, brain, spinal cord, intestine, pancreas, liver, bile ducts, kidney, esophagus, heart, ear, nose, muscle, blood, bone, cartilage, and teeth. Many of the genes and critical pathways that are required to grow these features are highly conserved between humans and zebrafish. Thus, any type of disease that causes changes in these body parts in humans could theoretically be modeled in zebrafish [19]. The major advantage of adult zebrafish is that they are small and preferred to be occupied in large groups so they need only less space, cheaper for maintenance when comparing with mice. The genome of zebrafish that are similar to humans will show a new path for screening of diseases and development of drug.

Characteristics of zebrafish that make it an animal model

Zebrafishes possess many characteristics that make it a valuable model for studying human genetics and disease. Zebrafish are popular animal models because since their advantageous are more when compared to other species [20]. In University of Oregon, George Streisinger and his colleagues launched a modern era to biomedical research by introducing new bio model – 'Zebrafish' [21]. The most valuable characters of them are that their genome is fully sequenced, and can be easily manipulated, high rate for production of off springs, less time for generation, rapid development of embryo (24 hours) and fertilization externally. The transparent nature helps in study of stages of development from the beginning of embryogenesis. Apart from that all the embryos develop to form a complete organ system that consists of intestine, heart and blood vessels soon after fertilization (48 hours). From the protein coding genes more than 10,000 mutants are developed [22] and the transgenic lines in the fish are made for human study. Another advantageous fact on them is availability of multiple strains that helps in species identification, and is also affordable to maintain large number in small area of laboratory space. It is also easy to manage, but require special attention on diet and water quality for optimization of growth. The above-mentioned reasons they are called popular biomedical model for research [23].

ZEBRAFISH IN THERAPEUTIC RESEARCH

The zebra fish is a biomedical tool that possesses potential application in the field of therapeutics in human diseases because of its high similarity with humans and other vertebrates. Zebrafish is mainly used to treat various genetic disorders. Recent research works are mainly focused in the use of zebrafish to treat malignancy and tumor genesis development [24]. The strong conservation of genetics, development and physiology between fish and humans has led to zebrafish models of a wide variety of health conditions including kidney disease [25], diabetes, pigment cell

disorders, aging [26], neurodegenerative diseases, such as Parkinson's [27], and retinal degeneration, scoliosis, epilepsy, blood disorders [28], cardiovascular and metabolic disorders. Pharmacological and drug development research mainly focused on zebra fish models to treat various disease and the discovery of compounds with therapeutic activity [29].

Zebrafish for cancer studies

Malignancy easily spreads in human body and nowadays the vertebrate model zebra fish are used in evaluate tumors [30, 31, 32] and molecular pathways for progression of tumors [33]. The analysis includes culture assays, phenotypes, molecular pathways, tumor proliferation for cancer or malignancy studies [34]. The induction of cancer in zebrafish needs *in vivo* monitoring of the tumor along with a professional imaging. Several imaging techniques are used now days for accuracy. For imaging the currently available quantitative platform is xenograft assay, 3D-fluorescence imaging with optical projection multiplexed, sensing for observation of progression of tumor, and development of vasculature in non-pigmented *Danio rerio* [35; 36]. The largest malignancy study is conducted in transgenic *Danio rerio* with mammalian oncogenes, it also uses other advantage of the animal bio-model by introducing foreign DNA to the cells and observation of its expression by injecting them to embryo (one - cell). Several model of *Danio rerio* are used for variety of malignancy evaluation and this is a new aid with spontaneous results [37].

The malignancy evaluation in *Danio rerio* is more fast and easier when compared to mouse model. The problem that reoccurs in *Danio rerio* is the presence of genome duplication fully or partially [38], which can affect the oncogenes and tumor suppressors in malignancy. The *Danio rerio in vivo* model provides several advantages in malignancy research than the *in vitro* traditional model and *in vivo* murine model. For the *in vivo* study of tumor genesis, the larvae of zebrafish, is a powerful model as it has many conservation genes with mammals. The optical clarity in zebrafish is highly efficient than mammals because of its non invasive investigation of the tumor cells and the single cell resolution in micro environment [39]. The use of human oncogenes, in conjunction with fluorescent reports are aid in the monitoring of tumor initiation, progression, the isolation and *in vivo* imaging of cancer cells [40].

Zebrafish and drug toxicity

Toxicity is one of the major concerns during the drug development process. In that line, cardiotoxicity, neurotoxicity, and hepatotoxicity are among the main reasons behind the exit of drugs in clinical phases and post market withdrawal. Use of zebrafish in high-throughput drug screening is becoming an important tool to assess the toxicity and efficacy of novel drugs. This animal model has, from early developmental stages, fully functional organs from a physiological point of view. Thus, drug induced organ toxicity can be detected in larval stages, allowing a high predictive power on possible human drug induced liabilities. Hence, zebrafish can bridge the gap between preclinical *in vitro* safety assays and rodent models in a fast and cost-effective manner [41]. Higher animals have been used to evaluate the drug toxicity for many years, and now zebrafish presents itself as a reliable vertebrate model to determine the developmental toxicity, general toxicity and to perform initial drug screening. Comparable results to the data obtained with higher models have been derived from its use, and reported [29]. Zebrafish model is an excellent vertebrate toxicological model with potential to contribute to significantly improve drug development in toxicology.

Zebra fish in studying human diseases

The family of vertebrate organism zebra fish contains some anatomical mechanism in humans. Mostly the high-level genetic modifications are analyzed in two different species. The zebra fish sequences are compares and study in this that genome contain 71% human protein and 82% of disease causing orthologs. In the past decades zebra fish was mainly used as the test sample of different disease. [42].

Studies on neurological disorders

Nowadays various researches are focused on use of zebra fish to treat neurobehavioral studies. The neuropath logical functions and the model phenotypes studies are analyzed in humans. In the drug development method used to different types of compounds are identified and analyzed in *in vivo* models.

Huntington's disease

The neurodegenerative disorder easily affects eye and the visualizing memory was easily destroyed [43]. Few genes associated with this disorder are identified from zebrafish and amino acid peptide sequences are discovered. In zebrafish, the huntingtin (Htt) gene has been cloned and sequenced with a 3121 predicted amino acid protein, which has 70% identity with the human peptide sequence [44].

Alzheimer's disease

Zebrafish possess human ortholog genes that play a vital role in Alzheimer's disease are classified in two types PSEN1 and PSEN2 orthologs [45]. The sub type of orthologs is called co-orthologs. These are divided into appa and appb are human APP orthologs [46]. The zebrafish genome also contains orthologous genes for gamma-secretase's complex components, PSENEN, NCTN and APH1b. In addition, β-secretase orthologs (BACE1 and BACE2) were also identified in zebrafish [47].

Parkinson's disease

Uncontrolled movements and different group of cognitive impairment are collectively known as Parkinson's disease. It is otherwise called motion disorder [48]. The human PARK2 ortholog in zebrafish resides on chromosome 13, and encodes a protein of 458 amino acids (465 in humans). The PINK1 zebrafish ortholog has 54% similarity [49]. Another type of ortholog is PARK7 which contains 182 amino acids coding the protein and 83% identical [50, 51].

Studies on hematological disorder

Diseases and disorders are caused with variation of blood cells are called as hematological disorder. The main function of blood cells is to protect from pathogens and ensures the oxygen supply. Some pathological functions and De Novo inherited genetic changes in blood cell formations and regulations that cause various diseases like cancer, hypo-inflammation, anemia, immune deficiency, auto-immunity [52]. Zebra fish erythropoiesis is one of the methods used to directly visualize zebra fish embryos. Fluorescent-activated-cell sorting (FACS) is the method used to the transgenic cell population and cDNA libraries are easily constructed [53]. This system is called as 'transgene electroporation [54].

Studies on cardiovascular diseases

Cardiovascular disease is one of the leading causes of death in the world. The risk factors for heart disease are hypertension, high blood cholesterol levels, diabetes, smoking, and obesity [55]. Different characteristics are identified in zebra fish that are used to treat Cardio vascular disease. Cardio vascular disease developments are found *in vivo* imaging is used in the zebra embryos. *In vivo* methods are used to observe different formation of the heart chambers, cardiac contraction, blood flow, and vessels. After individual gene screening of affected candidate, the potential *in vivo* effect was tested in zebrafish [56, 57]. From the recent researches on targeted gene screen candidate re- sequencing, among the 32 genes of candidates from 190 coronary heart disease patients, 11 novel genes coding for SNPs responsible for AVS defects was identified [58]. Expression of the patient specific L343P variant of ALK2 in zebrafish resulted in a malformation of the AV canal and compromised expression of endocardial cushion markers [59].

Studies on muscular disease

Muscular dystrophy is a hereditary disease which causes weakness and loss of muscle mass [60]. As both humans and zebrafish have high similarity and conservation of muscle genes it is an excellent bio model for research in human diseases myopathy and muscular dystrophy [61]. The strain of zebra fish named sapje has mutated genes of dystrophin (DMD) that alters the sequence of protein coding and causes loss of muscle weight, muscle integrity loss

which is similar to as that of DMD mutations in humans [62]. By using random chemical mutagenesis in zebrafish models, researchers have studied varieties of human diseases [63] and genomic mutagenesis such as ZFNs etc [64].

Anxiety and posttraumatic stress disorder studies

The anxiety disorders are developed because of acute stress**.** Neurophysiology and behavior of neurotransmitter systems in zebra fish is same as that of mammals which includes humans. But still the link between behavior of zebrafish and the release of neurotransmitter from its brain is unclear. Almost all the currently available protocol makes indirect approach for description of neurochemical events in zebrafish [65]. The main excitatory and inhibitory neurotransmitters in the central nervous system, is Glutamate and GABA. Both play an important role in generating anxiety, by introducing acute stress in zebrafish which keeps it as important animal model for research on behavior introduced by acute stress [66]. When exposed to stimuli that evoke fear or anxiety, zebrafish display a wide range of clear-cut quantifiable behaviors, including markedly reduced exploration, increased scototaxis, geotaxis, thigmotaxis, freezing and erratic movements [67]. They show behaviors that are similar to mice and humans, the traditional biomarkers that are available to explore the same function and identical roles across these species [68]. Cortisol ELISA kits is used to measure Cortisol in zebrafish [69]. The similarities in the stress response between humans and zebrafish support the utility of the zebrafish as a model for stress and anxiety mediated behavior.

TOXICITY STUDIES

Compared to *in vitro* studies, the zebrafish-based toxicity experiments give more accurate and effective results for higher vertebrates including humans. The unique characters of Zebrafish help to give better toxicity analysis report for whole animal system with very less time. Because of their quantity in embryo production and short-term development, they are also involved in the assessment of environmental pollution rate. [70].

Cardiotoxicity

For the cardiotoxicity studies, zebrafish is the excellent model for human system [71]. For myocardiocyte and differentiation studies, the Ca^{2+}ions are needed and the cell coupling helps to attain proper calcium ions. In the case of zebrafish, it provides voltage mapping to achieve cardio studies [72]. Before few years, for all toxicity studies the large animals are used like mice, rats, monkey and rabbits, but has some limitations such as rodents can be insensitive to compounds responsible for cardiotoxicity, particularly when the endpoint measurement is left ventricular contractile function [73]. Similarly, the heart anatomy is very close to humans, the electrical capacity and chambers are similar, the rates of heart beats are also related. The explosion of electrical activity and molecular regulators are shown higher similarity to humans [74]. Currently, new methods have been followed for heart examination of zebrafish without contact or skin break approach. This method helps to avoid the conventional methods, because, it makes alterations in heart activity and acute myocardial motion during cardiac examination. The factors or toxins that affect the heart such as nanoparticles, pollutants in the environment [75] alcohols, psychoactive drugs [76] and effect of cigarette smoke on the cardiovascular system are analyzed through the embryos of zebrafish. When the zebrafish was exposed to cigarette smoke and check the heartbeat, is varied by 50% at 48-hpf [77]. Other than cigarette usage, the continuous consumption of alcohol also altered the activity of zebrafish heart **[**78**].** Cardiotoxicity evaluation of anti-cancer drugs is frequently performed in zebrafish. Cancer patients usually suffer the complications of chemotherapy due to its cardiotoxic effect [79].

Hepatotoxicity

Zebrafish larva is used to evaluate the human liver function and toxicity; it is an excellent model for hepatotoxicity [80]. The liver of zebrafish starts its development at the third day of post fertilization and it completely functionalized at the fifth day [81]. Most of the mammals have three lobes and the zebrafish also have the same so the biological functions of both mammals and zebrafish are same, including the production of biological materials such as amino acids, proteins, vitamins [82]. Some studies reported that, the metabolic action of many drugs in both humans and zebrafish are almost similar. The enzyme cytochrome P450 is responsible for many biological metabolic actions including hydroxylases, combination of two or more biological substances, formation of oxide process of

removal of methyl groups, the zebrafish possess large quantity of cytochrome P450 [83]. The zebrafish treated with hepatotoxic drugs; the histological pattern of the liver is shown same as like human liver exposed with the hepatotoxic drugs [84]. The production of Vitellogenin may affect by the hepatotoxicity, based on the OECD guidelines, in this study the adult zebrafish were exposed with three hepatotoxicants, Acetaminophen, Isoniazid and Aspirin [85]. The usage of these drugs could alter the liver functions and morphology include, hypertransaminasemia, antioxidant enzymes action, chemically reactive chemical species content and mRNA are studied by researches in different projects related to hepatotoxicity [86, 87].

ANGIOGENESIS AND REGENERATION

Angiogenesis is a process, formation of new circulatory system from pre-existing ones and performing important functions in our body including, embryogenesis and tissue regeneration. Moreover, to improve the action of therapeutic angiogenesis is the main aim in the field of translational research. Sometimes the action of angiogenesis affects our body in a wrong way, for tumor growth angiogenesis is the main supporting factor. Suppressing the action of angiogenesis is a main therapeutic method for inhibit the tumor growth. [88].

The most unique feature of zebrafish is that, it has very transparent embryo and larva; by using this advantage we can easily observe the blood flow without the help of any instrument. The studies on this have reported the conservation of different genetic pathways among fish and humans and are most useful for disease biology and human health [98]. While inhibition of gene expression was not suitable with zebrafish, the short DNA or RNA molecules named Morpholino oligomer, facilitate the knockdown of endogenous genes during RNA processing [89]. This method has some limitations such as the initiation of unwanted effects at delayed developmental stages due to its decreasing effect over a time [90].

ZEBRAFISH AS A MODEL IN AQUACULTURE

Production of more usable aquaculture products, the aquaculture industry continues to promote investing a variety of ingredients for aqua feed. Most of the aquaculture diet are expensive and take more time for trials in each species but zebrafish cross these barriers as an experimental model [91]. By using zebrafish, there are many diets tested because of its high throughput testing. This teleost fish has lots of unique features connected to its life cycle, flexible to handling and more similar to human biology, apart from *in vivo* analysis with other fishes [10]. For the large-scale production, the researchers have developed improved animal house and endurance, immune response and feed have been conceded out in zebrafish, and the outcome of research is they are commercially suitable model [92].

One of the advantages of zebrafish in aquaculture is they can be easily handled during reproduction and also in experiments, the required time for reproduction is very less (~3 months) and large number of eggs per offspring (100–200 eggs/clutch), express whole analyses with huge number of specimens per data point. After implantation the embryos hatch at two days and for five days the larvae cannot feed and during this period the body is fully functional, this system expresses a similar physiology to humans. Different live feed for both adult and larvae and also variety of common fish diets are available [93]. The diet is very important for aquaculture and always there is relationship between the genome and diets. There are two methods followed in aquaculture for maintaining diet needs first one is Nutrigenomics, it gives the detail explanation for the ingredients in diet that affect the activity of genes and the second one is the Nutrigenetics, which gives the details of genetic makeup manage in response to diet [94]. These two methods clarify the action of dietary ingredients that alter gene expression and individual genetic activity.

ADVANTAGES OF ZEBRAFISH OVER OTHER ANIMAL MODELS

The zebrafish was used as research animal model in all the area of biology. All over the world around eight hundreds research laboratories use zebrafish for their research as stated in ZFIN website. Most of the researches in zebrafish are based on human diseases, including neurological disorders, different types of tumors, viral infections, heart related problems, renal failure, diabetes, vision problems, respiratory diseases, hematological disorders and neuromuscular disorders [95].

Zebrafishes are intensively used as a model because of its unique developmental process in which the embryos are transparent and they develop outside of the uterus that benefits scientists to study the process of development from fertilization in detail [23]. Prominent features of zebrafish include, completely sequenced genome, easy manipulation of its genome, less time required for reproduction and fertilization etc. Zebrafishes are generally translucent in nature which enhances researchers to study the fetal development stages. Furthermore, zebrafish fetus within 48 hours, grow into fully organ systems, contain cardio system, digestive and circulatory system after implantation. The protein coding genes are around 10,000; these mutants have several transgenic lines in zebrafish that enhances the research on human diseases [22]. Various breeds of zebrafish are added feature of these biomedical models in research.

Maintenance of zebrafishes in laboratories is inexpensive and easily manageable as it requires minimal laboratory space however, special attention must be paid in providing a healthy diet and adequate water to enhance fish health and growth. Among the different breeds of zebrafish, the most widely used breed for research are AB, Casper, Ekkwill, Nadia, Wild Indian Karyotype, wild-caught, and Tubingen. Genetic alterations by knocking out or knocking in specific genes develop new models for scientific studies. For instance, in order to study gene expression of metabolic disorders in patients, corresponding zebra fish models have been developed with disease related genetic alterations and monitored [96].

LIMITATIONS

The main limitation of zebrafish when compared to mammals is that, variations in some particular organs such as intestines and the genital of the body makes difficult to set zebrafish as a model for gentile or digestive related diseases. Another important limitation is zebrafish can't express the effect of water-soluble drugs because it lives in water environment [97]. The required reproduction time for zebrafish is very less which is an advantage for research but sometimes this short time reproduction makes it hard to create constant transgenic adults, normally four months needed for the development of a matured adult. [20]. The occurrence or lack of addition of genome in zebrafish makes some complications to study such a type of diseases like blood sugar.

CONCLUSION

In biological studies, each experimental animal model has significant role. The research outcome is more reliable and accurate when it is done with animal models. From the past few years zebrafish is the most commonly used experimental model for introducing novel treatment methods or the identification of new drugs. Zebrafishes are excellent model for the study of gene function, screening of various organs in an infected stage, for different tumors, toxicity studies, various disorders and in aquaculture, etc. These features make zebrafish a good research model with less expense, easy to handle, very clear embryo, flexible management, large productiveness and low reproduction duration that other research models lack.

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RESEARCH ARTICLE

Quasi Ideals in Ternary Seminear Rings

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ABSTRACT

We define the notion of quasi ideals in ternary seminear ring and their properties are obtained. we also describe minimal quasi ideal in ternary seminear ring and study some of their interesting results.

Keywords: *Ternary seminear ring, Regular Ternary seminear ring, Ideals in Ternary seminear ring*
AMS Subject Classification code: 16Y30,16Y99,17A40,18A32

INTRODUCTION

A huge deal of research has been done and is being done in the field of ternary algebra. The theory of ternary operations is enormous and to separate and go over various field of mathematics. In 19th century Cayley introduced and started a work on ternary algebraic operations. Later Cayley's ideas put forward and enlarged n-ary generalizations of matrices and their determinants [5][11] and developed further theory on n-ary algebras [1][6][8]. Lister.W.G. came up with ternary rings [9]. In 1956, German mathematician Steinfield.O. fathered on Quasi ideal [12][13]. On Quasi ideals of semi rings was defined by Christoph Donges [2]. Dixit.V.N and Dewan.S., [3] gave a note on quasi and bi-ideals in ternary semigroups. In 2005, Kar.S.[4] initiated on quasi-ideals and bi-ideals in ternary semi rings. Later Koteswaramma. N and Venkateswara Rao. J.[7] brought up with Quasi-ideals and Minimal quasi-ideals in ternary semirings. Manish Kant Dubey and Anuradha [10], floated on quasi ideals and a note on prime quasi-ideals in ternary semi ring. In 2020, we came up with the notion of ternary seminear rings [14]. Our work on ternary seminear rings found in [15,16].In this paper we introduce the notion of quasi-ideal in ternary seminear ring and obtain their properties. And also define the minimal quasi ideal in ternary seminear ring and derive some of their theorems in it.

PRELIMINARIES:

This section recalls some basic definitions and results which are used in this paper.

DEFINITION: 2.1:[2] A nonempty subset Q ⊆ S of a semiring(S,+,.) is called a Quasi ideal of S if Q is a subsemigroup of (S,+) satisfying (SQ) ∩ (QS) ⊆ Q.

DEFINITION: 2.2:[14] A ternary seminear ring is a nonempty set T together with a binary operation called addition '+' and a ternary operation called ternary multiplication denoted by juxtaposition, such that (i)(T, +) is a semigroup.
(ii)T is a ternary semigroup under ternary multiplication.
(iii)xy(z + u) = xyz + xyu for all x, y, z, u ∈ T.

DEFINITION: 2.3:[14] A ternary seminear ring T is said to have an absorbing zero if there exists an element 0 ∈ T such that i)x + 0 = 0 + x = x for all x ∈ T. ii)xy0 = x0y = 0xy = 0 for all x, y ∈ T.

REMARK: 2.4:[14] Throughout this paper T will always stand for the ternary seminear ring and it will always mean that ternary seminear ring with an absorbing zero.

DEFINITION: 2.5 : [14] Let T be a ternary seminear ring (T,+,.). A non empty subset I of T is said to be a left(lateral and right) ideal of T if it holds the following conditions i) i + j ∈ I for all i, j ∈ I ii) t_1t_2i(respectively t_1it_2, it_1t_2) ∈ I for all t_1, t_2 ∈ T and i ∈ I. If I is a left, a lateral and a right ideal of T then I is said to be an ideal of T.

DEFINITION: 2.6:[15] An element x in a ternary seminear ring T is called regular if there exists an element y in T such that xyx=x. A ternary seminear ring T is called regular if all of its elements are regular.

THEOREM:2.7:[16] Let T be a ternary seminear ring. Then the following conditions are equivalent
i) T is regular.
ii) For any right ideal A, lateral ideal B, left ideal C of T, $ABC = A \cap B \cap C$.
iii) For $x, y, z \in T, < x >_r < y >_m < z >_l = < x >_r \cap < y >_m \cap < z >_l$
iv) For $x \in T, < x >_r < x >_m < x >_l = < x >_r \cap < x >_m \cap < x >_l$

QUASI IDEALS IN TERNARY SEMINEAR RINGS:

In this section we discuss the Quasi ideals in ternary seminear rings.

DEFINITION: 3.1: Let T be a ternary seminear ring. Let U be an additive subsemigroup of T. *U is said to be a quasi-ideal of T if* $UTT \cap (TUT + TTUTT) \cap TTU \subseteq U$.

REMARK: 3.2:
(i) Each quasi ideal of a ternary seminear ring T is a ternary subseminear ring of T.
(ii) Each right, lateral and left ideal of a ternary seminear ring T is a quasi ideal of T.

THEOREM: 3.3: Let T be a ternary seminear ring. An intersection of an arbitrary collection of quasi ideals of T is also a quasi ideal of T.

Proof. Let $\{U_i : i \in I\}$ be any family of quasi ideals of a ternary seminear ring T. Let $a, b, c \in \bigcap_{i\in I} U_i$. Then $a, b, c \in U_i$ for all $i \in I$. Since every U_i is a quasi ideal of T, we have $abc \in U_i$ for all $i \in I$ which implies that $abc \in \bigcap_{i\in I} U_i$. Since U_i is a quasi ideal of T, $U_iTT \cap (TU_iT + TTU_iTT) \cap TTU_i \subseteq U_i$ and $\bigcap_{i\in I} U_i \subseteq U_i$ for all $i \in I$. Then we have

$$[(\bigcap_{i\in I} U_i)TT] \cap [T(\bigcap_{i\in I} U_i)T + TT(\bigcap_{i\in I} U_i)TT] \cap [TT(\bigcap_{i\in I} U_i)] \subseteq U_iTT \cap (TU_iT + TTU_iTT) \cap TTU_i \subseteq U_i, \text{ for all } i \in I.$$

This implies that

$[(\underset{i\in I}{\cap} U_i)TT] \cap [T(\underset{i\in I}{\cap} U_i)T + TT(\underset{i\in I}{\cap} U_i)TT] \cap [TT(\underset{i\in I}{\cap} U_i)TT] \subseteq \underset{i\in I}{\cap} U_i$.
Hence $\underset{i\in I}{\cap} U_i$ is a quasi ideal of T.

THEOREM: 3.4: Let T be a ternary seminear ring and R be a ternary subseminear ring of T. If U is a quasi ideal of T, then U ∩ R is a quasi ideal of R.

Proof. Since $U \cap R$ is a subsemigroup of $(T, +)$ and $U \cap R \subseteq R$, then $U \cap R$ is a subsemigroup of $(R, +)$.

$$[RR(U \cap R)] \cap [R(U \cap R)R + RR(U \cap R)RR] \cap [(U \cap R)RR] \subseteq$$
$$RRU \cap (RUR + RRURR) \cap URR \subseteq TTU \cap (TUT + TTUTT) \cap UTT \subseteq U$$

Again,

$$[RR(U \cap R)] \cap [R(U \cap R)R + RR(U \cap R)RR] \cap [(U \cap R)RR] \subseteq$$
$$RRR \cap (RRR + RRRRR) \cap RRR \subseteq R.$$

Consequently,

$$[RR(U \cap R)] \cap [R(U \cap R)R + RR(U \cap R)RR] \cap [(U \cap R)RR] \subseteq U \cap R$$

Hence $U \cap R$ is a quasi ideal of R.

THEOREM: 3.5: Let T be a ternary seminear ring. An additive subsemigroup U is a quasi ideal of T if U is the intersection of a right, a lateral and a left ideal of T.

Proof. Let T be a ternary seminear ring. Let A be a right ideal, B be a lateral ideal and C be a left ideal of T such that $U = A \cap B \cap C$. By remark 3.2(ii) and by theorem 3.3. $UTT \cap (TUT + TTUTT) \cap TTU \subseteq U$ we have that U is a quasi ideal of T.

DEFINITION: 3.6: Let T be a ternary seminear ring. A non zero quasi ideal U of T is said to be minimal if U does not properly contain any non zero quasi ideal.

THEOREM: 3.7: Let T be a ternary seminear ring. An additive subsemigroup U is a minimal quasi ideal of T ⇔ U is the intersection of a minimal right ideal, a minimal lateral ideal and a minimal left ideal of T.

Proof. Let T be a ternary seminear ring. Let A be a minimal right ideal, B be a minimal lateral ideal and C be a minimal left ideal of T such that $U = A \cap B \cap C$. By theorem 3.5, we have U is a quasi ideal of T. Now its enough to show that U is minimal. Let $U' \subseteq U$ be any quasi ideal of T. Then TTU' is a left ideal of T and $TTU' \subseteq TTU \subseteq TTC \subseteq C$. As C is a minimal left ideal of T, $C \subset TTU'$, we have $TTU' = C$. Similarly we show that $TU'T + TTU'TT = B$ and $U'TT = A$. Therefore $U = A \cap B \cap C = U'TT \cap (TU'T + TTU'TT) \cap TTU' \subseteq U'$. Hence $U = U'$ and therefore U is a minimal quasi ideal of T. Conversely, let U be a minimal quasi ideal of T. Then $UTT \cap (TUT + TTUTT) \cap TTU \subseteq U$. Let $u \in U$. Then uTT be a right ideal, $(TuT + TTuTT)$ be a lateral ideal and TTu be a left ideal of T from theorem 3.3. $uTT \cap (TuT + TTuTT) \cap TTu$ is quasi ideal of T and $uTT \cap (TuT + TTuTT) \cap TTu \subseteq UTT \cap (TUT + TTUTT) \cap TTU \subseteq U$. As U is a minimal quasi ideal of T, $uTT \cap (TuT + TTuTT) \cap TTu = U$. Now its enough to show that uTT is a minimal right, $(TuT + TTuTT)$ is a minimal lateral and TTu is a minimal left ideal of T. Let A be any right ideal of T such that $A \subseteq uTT$. Then $ATT \subseteq A \subseteq uTT$. Now, $ATT \cap (TuT + TTuTT) \cap TTu \subseteq uTT \cap (TuT + TTuTT) \cap TTu = U$. By minimality of U, we found that $U = ATT \cap (TuT + TTuTT) \cap TTu$, which implies that $U \subseteq ATT$ and $uTT \subseteq UTT \subseteq ATT$. Thus $uTT = ATT \subseteq A$. Thus $A = uTT$. Therefore uTT is a minimal right ideal of T. Similarly, we can $(TuT + TTuTT)$ is a minimal lateral ideal and Tuu is a minimal left ideal of a ternary seminear ring.

THEOREM: 3.8: Let T be a ternary seminear ring. Any minimal lateral ideal of T is a minimal left ideal of T.

Proof. Let T be a ternary seminear ring. Let B be a minimal lateral ideal of T. We show that B be a minimal left ideal of T. Let $b \in B$. Then $TbT + TTbTT$ is a lateral ideal of T and $TbT + TTbTT \subseteq TBT + TTBTT \subseteq B$. As B be a minimal lateral ideal, $B = TbT + TTbTT$. Now,

$$\begin{aligned} TTB &= TT(TbT + TTbTT) \\ &= TT(TbT) + TT(TTbTT) \\ &\subseteq TbT + TTbTT \\ &\subseteq B \end{aligned}$$

This implies that B is a left ideal of T. Now its enough to show that B is a minimal left ideal of T. Let B' be a left ideal of T such that $B' \subseteq B$. As B' is a left ideal of T,then its a lateral ideal of T. Since B is minimal lateral ideal, $B \subset B'$. Then $B' = B$. Therefore B is a minimal left ideal of T.

THEOREM: 3.9: Let T be a ternary seminear ring. Any minimal quasi ideal of T is contained in a minimal lateral ideal of T and hence it is also a minimal left ideal of T.

Proof. Let T be a ternary seminear ring. U is a minimal quasi ideal of T. Then from theorem 3.7, $U = A \cap B \cap C$, where A be a minimal right ideal ,B be a minimal lateral ideal and C be a minimal left ideal of T. Then $U \subseteq B$. Then from theorem 3.8, B be a minimal left ideal of T.

THEOREM: 3.10: If for each quasi ideal U of a ternary seminear ring T, $U^3 = U$, then T is a regular ternary seminear ring.

Proof. Let T be a ternary seminear ring. If A be a minimal right ideal, B be a minimal lateral ideal and C be a minimal left ideal of T, then by theorem 3.7, $A \cap B \cap C$ be a quasi ideal of T. By assumption,

$$\begin{aligned} A \cap B \cap C &= (A \cap B \cap C)^3 \\ &= (A \cap B \cap C)(A \cap B \cap C)(A \cap B \cap C) \\ &\subset ABC \end{aligned}$$

Also clearly $ABC \subseteq A \cap B \cap C$. Therefore $ABC = A \cap B \cap C$. By theorem 2.7, T be a regular ternary seminear ring.

THEOREM: 3.11:*If U is a quasi ideal of a ternary seminear ring T, then $U^3 = UUU \subseteq U$.*

Proof. Let T be a ternary seminear ring. U be a quasi ideal of T. Therefore

$$TTU \cap (TUT + TTUTT) \cap UTT \subseteq U.$$

Then

$$\begin{aligned} U^3 &= UUU \subseteq TTU \\ U^3 &= UUU \subseteq UTT \quad and \\ U^3 &= UUU \subseteq (TUT + TTUTT). \end{aligned}$$

Therefore $U^3 \subset TTU \cap (TUT + TTUTT) \cap UTT \subseteq U$

Hence $U^3 = UUU \subseteq U$.

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RESEARCH ARTICLE

Standardization of Siddha Herbal Formulation Nelli Mulli Ilagam for Iron Deficiency Anaemia

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ABSTRACT

Siddha system is the earliest Dravidian system of medicine presently practiced primarily in South India[1]. Most of the traditional system of medicines are successful but they lack of standardization. So, there is a need to develop a standardisation technique. In Siddha, various herbal, herbo-mineral drugs are mentioned for the management of *Pitha Paandu* (Iron Deficiency Anaemia).The present study aims to standardize the Siddha herbal formulation *Nelli Mulli Ilagam*, which is mentioned in the Siddha classical text *AgasthiyarVaidhyaVallathi 600* indicated for *Pitha paandu* (Iron Deficiency Anaemia). The drug prepared as per the method mentioned in the Siddha literature. Scientific documentation to standardize this drug is essential now a days. This medicine has been standardized on the basis of organoleptic characters, heavy metal analysis, physico chemical characters, phytochemical analysis, aflatoxin analysis and bio chemical analysis conducted on *NelliMulliIlagam* revealed that the presence of bio active molecules alkaloids, flavonoids, triterpenoids, phenol, Steroids, Anthocyanin, tannin, Carbohydrate, protein were detected. This research article will report safety and efficacy data for the herbal formulation *Nelli Mulli Ilagam* through standardization.

Keywords: Siddha drug, Standardization, *Nelli Mulli Ilagam*, Iron Deficiency Anaemia

INTRODUCTION

Siddha system of medicine is customary system of healing that arise in South India and is think about to be one of the ancient systems of medicine[2]. The herbal drugs described in Siddha system have been the basic treatment of various human diseases. WHO specific guidelines for the assessment of the safety, efficacy and quality of herbal medicines are most important[3].The standardization of any drug is done by stepwise quality control methods as

prescribed by Pharmacopeia laboratory standards of Indian Medicine[4].In Siddha, various herbal drugs are mentioned for the management of *PithaPaandu* (Iron Deficiency Anaemia). The present study aims to standardize the Siddha herbal formulation *NelliMullillagam*, which is mentioned in the Siddha classical text *AgasthiyarVaidhya Vallathi 600* indicated for *PithaPaandu* (Iron deficiency Anaemia).Till date, there is no standard available for *Nelli Mullillagam*. Hence, the current study has been carried out to assess its Physicochemical, Phytochemical and other standardization parameters as part of their scientific validation.

MATERIALS AND METHODS

Standard operating procedure for *Nelli Mulli Ilagam*

Required raw drugs:

1. Nellimulli (*Phyllanthus emblica*) - 20 *palam* (700 gm)
2. Athimadhuram (*Glycyrrhiza glabra*) - 2 *palam*(70 gm)
3. KoogaiNeeru (*Maranta arundinacea*) - 2 *palam* (70 gm)
4. Thiratchai (*Vitisvinifera*) - 2*palam* (70 gm)
5. Thippili (*Piper longum*) - 3 *palam* (105 gm)
6. Perinthu (*Phonex dactilifera*) - 3*palam* (105 gm)
7. Naatusarkarai (Brown Sugar from Sugar cane) - 25 *palam* (875 gm)
8. Honey -½ *padi* (750 ml)

Purification of Trial Drugs

Nelli Vattral

Dried fruit of Nellikai (*Phyllanthus emblica. Linn*) were boiled with cow's milk and then seed was removed.

Thippili

Thippili (*Piper longum. Linn*) was soaked in lime juice and then dried.

Athimadhuram

Athimadhuram (*Glycerrhiza glabra. Linn*) was rinsed with fresh water and then external layer was removed. Then it was cut into small pieces and then dried.

KoogaiNeeru

KoogaiKizhangu (*Maranta arundinacea. Linn*) flour was mixed thoroughly in fresh water and left aside to settle. Then, the supernatant liquid was discarded. This method was carried out for another 6 times. At the end, the powder settled in the bottom of the vessel was separated and dried during the night.

Thiratchai

Clean and dried it under shadow

Perinthu

Clean and dried it under shadow

Sarkarai:

Sugar (NaatuSarkarai) was made into fine powder by grinding in mortar.

METHOD OF PREPARATION

Step 1: 20 *Palam* (700 grams) of dried fruits of nellikai (*Phyllanthusemblica. Linn*) was taken and 32 *padi* (48 liters) of fresh water was added and boiled till reduces to 4 *padi* (6 liters).

Step 2: 25*palam* (875 grams) of sugar was added and boiled till it attains" paagupatham".

Step 3:

Athimadhuram (*Glycerrhiza glabra, Linn*),
KoogaiNeeru (*Maranta arundinacea, Linn*), 2 *palam* (70 grams)
Thiratchai (*Vitisvinifera, Linn*)
Perinthu (*Phonex dactilifera, Linn*),
Thippili (*Piper longum, Linn*) 3 *palam* (105grams)

Above drugs were powered and mixed with the prepared paagu. Then ½*padi* (750 ml) of honey was added to the above preparation till it attains Legium Patham (Semi solid consistency).

Standardization parameters

The organoleptic characteristic (Appearance, colour, odour, taste and touch) tests for presence of Heavy metals (such as arsenic, mercury, cadmium and lead), Pesticides residues, Microbial load and specific pathogen contamination, Physicochemical evaluation; PH value, ash values, alcohol soluble extractive value, loss on drying and preliminary phytochemical screening, analysis of aflatoxin, TLC and HPTLC were studied as per standard operation procedures at Nobel research solution, Chennai.

Organoleptic Study[5].

Colour

The *NelliMullilIagam* was taken into watch glasses and placed against white back ground in white tube light. It was observed for its colour by naked eye.

Odour:

The *NelliMullilIagam* was smelled twice individually with an interval of 2 minutes.

Taste

Small amount of *NelliMullilIagam* was kept over the tip of the tongue

Physico Chemical Analysis[6]

Percentage Loss on Drying

NelliMulliIlagam sample was dried at 105ºC for 5 hours and then weighed.

Determination of Total Ash

NelliMullilIagam sample was accurately weighed in silica dish and burn up at the forge a temperature 400 ºC until it turns white in colour which indicates absence of carbon.

Determination of Acid Insoluble Ash

The ash obtained by total ash test was boiled with 25 ml of dilute hydrochloric acid for 6minutes. Percentage of acid insoluble ash was calculated with reference to the weight of air-dried ash.

Determination of Alcohol Soluble Extractive

Nelli Mulli Ilagam sample was soaking with 100 ml of Alcohol in a closed container for 24 hours. Then it was trembling frequently for six hours and allowing it to stand for 18 hours. Filter rapidly, taking provision against loss of solvent, evaporate 25 ml of the filtrate to dryness in a tared flat bottomed shallow dish, and dry at 105ºC, to constant weight and weigh. Calculate the percentage of alcohol-soluble extractive with reference to the air-dried drug.

Determination of Water Soluble Extractive

Above the same procedure was done for determination of water soluble extraction. 100 ml of chloroform water was added instead of alcohol. Otherwise same procedure was followed.

Test for specific pathogens

Methodology

Nelli Mulli Ilagam sample was directly injected in to the specific pathogen medium (EMB, DCC, Mannitol, Cetrimide) by pour plate method. The plates were incubated at 37°C for 24 - 72h for observation. Presence of specific pathogen identified by their characteristic colour with respect to pattern of colony formation in each differential media.

PHYTOCHEMICAL ANALYSIS[7]

Phytochemical analysis was done by proper bio – chemical procedure at Bio-medical lab.

S.NO	EXPERIMENT	OBSERVATION	INFERENCE
1	Apperance of sample	Dark brown in colour.	Dark brown in colour.
2	**SOULBILITY** a) Altitle of the sample is shaken with distilled water. b) A little of the sample is shaken well with conc HCL/conc H_2SO_4.	Sparingly soluble. Completely soluble.	Sparingly Insoluble
3	**ACTION OF HEAT** A small amount of the sample is taken in a dry test tube and heated gartly at first and then strong.	White fumes evolved No brown fumes.	**Presence of carbonate**
4	**FLAME TEST:** A small amount of the sample is made into a paste will conc. HCL in a watch glass and introduced into non luminous part of the Bunsen flame.	No Bluish green flame appeared.	Absence of copper
5	**ASH TEST:** A filter paper is soaked into mixture of the sample and cobalt nitrate solution and introduced into bursen flame and ignited.	No yellow colour flame.	Absence of Sodium

1.Test for Acid Radicals

S.NO	PROCEDURE	OBSERVATION	INFERENCE
1	**TEST FOR SULPHATE** A) 2ml of above prepared extract is taken in the test tube to this added 2ml of 4% ammonium oxalate solution. B) 2ml pof the above prepared extract is added with 2ml of dilution HCL is added until the effervescence ceases off. Then 2ml of barium chloride solution is added	No Cloudy appearance present. A white precipitation insoluble in conc.HCL is obtained.	Absence of sulphate
	TEST FOR CHLORIDE: 2ml of above the prepared extract is added with dilution hno3 till the effervescence ceases. Then 2ml of is treated with sliver nitrate solution.	No cloudy appearance present.	Absence of Chloride
3	**TEST FOR PHOSPHATE** 2ml of extract is treated with 2ml of ammonium molybdate solution and 2ml of conc.HNO3.	Cloudy yellow appearance present.	**Presence of Phosphate**
4	**TEST FOR CARBONATE** 2ml of the extract is treated with 2ml of magnesium sulphate solution.	Cloudy appearance present.	**Presence of Carbonate**
5	**TEST FOR FLUORIDE AND OXALATE** 2ml of extract is added with 2ml of acetic acid and 2ml of calcium chloride solution and heated.	No cloudy appearance present.	Absence of Fluoride and Oxalate

6	**TEST FOR NITRITE:** 3 drops of the extract is placed on the filter paper on that 2 drops of acetic acid and 2 drops of benzidine solution is placed.	No characteristics changes.	Absence of Nitrate

Test for Basic Radicals

S.NO	PROCEODURE	OBSERVATION	INFERENCE
1	**TEST FOR LEAD:** 2ml of the extract is added with 2ml of potassium iodide solution.	No yellow precipitate is obtained.	Absence of Lead
2	**TEST FOR COPPER:** a) One pinch of substance is made into paste with conc HCL in a watch glass and introduced into non luminous part of the flame. b) 2ml of the extract is added with excess of ammonia solution.	No Blue colour flame No Blue colour precipitate formed.	Absence of Copper
3	**TEST FOR ALUMINIUM**: To the 2ml of extract sodium hydroxide is added in drops to excess.	No characteristics changes.	Absence of Aluminium
4	**TEST FOR IRON**: a) To the 2ml of extract add 2ml of Ammonium thiocyaniate solution. b) To the 2ml of extract 2ml of Ammonium thiocyanate solution and 2ml of conc HNO3.	Blood red colour appeared.	**Presence of Iron**
5	**TEST FOR ZINC:** To 2ml of the extract sodium hydroxide solution is added in drops to excess.	White precipitate formed.	**Presence of Zinc**
6	**TEST OF CALCIUM:** 2 ml of the extract is added with 2 ml of 4% ammonium oxalate solution	Cloudy appearance and white precipitate is obtained	**Presence of Calcium**
7	**TEST FOR MAGNESIUM:** To 2 ml of extract sodium hydroxide solution is added in drops to excess.	White precipitate is obtained	**Presence of Magnesium**
8	**TEST FOR AMMONIUM** To 2 ml of extract few ml of Nessier's reagent and excess of sodium hydroxide solution are added.	No brown colour appeared	Absence of Ammonium
9	**TEST FOR POTASSIUM:** A pinch of substance is treated with 2 ml of sodium nitrate solution and then treated with 2 ml of cobalt nitrate in 30% glacial acetic acid.	No yellowish precipitate is obtained	Absence of Pottasium
10	**TEST FOR SODIUM:** 2 pinches of the substances is made into paste by using HCL and introduced into the blue flame of Bunsen burner.	No yellow colour flame appeared	Absence of Sodium
11	**TEST FOR STARCH** 2 ml of extracts was treated with weak Iodine solution.	No blue colour formation	Absence of Starch

12	**TEST FOR REDUCING SUGAR** 5 ml of Benedict's qualitative solution was taken in a test tube and allowed to boil for 2 minutes and 8 – 10 drops of the extracts was added and again boil it for 2 minutes.	Brick red colour was developed	**Presence of Reducing Sugar**
13	**TEST FOR ALKALOIDS** 2 ml extracts was treated with 2 ml of Potassium Iodide solution and 2 ml Picric acid was added.	Yellow colour was developed	**Presence of Alkaloids**
14	**TEST FOR TANNIC ACID** 2 ml of the extract was treated with 2 ml of Ferric solution. Black precipitate as formed indicating the presence of Tannic acid.	Yellow colour was developed	**Presence of Tannic acid**

Tlc And Hptlc Analysis[8]

TLC Analysis

Nelli Mulli Ilagam sample was subjected to thin layer chromatography (TLC) as per conventional one dimensional ascending method using silica gel 60F254, 7X6 cm (Merck) were cut with ordinary household scissors. Plate markings were made with soft pencil. Micro pipette were used to spot the sample for TLC applied sample volume 10-micro litre by using pipette at distance of 1 cm at 5 tracks. In the twin trough chamber with the specified solvent system after the run plates were dried and was observed using visible light Short-wave UV light 254 nm and light long-wave UV light 365 nm.(Table 4)

Chromatogram Development

It was accomplished in CAMAG Twin Trough chambers. Sample elution was achieved according to the adsorption capability of the component to be analyzed. After wash out, plates were drawn out of the chamber and dried.

Scanning

Plates were scrutinize under UV at 366nm. The data obtained from scanning were brought into unification through CAMAG software. Chromatographic finger print was developed for the detection of phyto-constituents present in each sample and their respective Rf values were tabulated.

Heavy metal analysis by aas

Standard: Hg, As, Pb and Cd – Sigma

METHODOLOGY

Atomic Absorption Spectrometry (AAS) is a very common and authentic technique for detecting metals and metalloids in environmental samples. The total heavy metal content of the sample was performed by Atomic Absorption Spectrometry (AAS) Model AA 240 Series. In order to discovery of the heavy metals such as mercury, arsenic, lead and cadmium concentrations in the test item.

Sample Digestion

Nelli Mulli Ilagam sample was dissolve with 1mol/L HCl for determination of arsenic and mercury. Similarly, for the discovery of lead and cadmium the sample were dissolve with 1mol/L of HNO3.

Standard reparation

As & Hg- 100 ppm sample in 1mol/L HCl

Cd &Pb- 100 ppm sample in 1mol/L HNO3

Aflatoxin Analysis[9]

Procedure

Standard aflatoxin was applied enforcedon to the surface to pre coated TLC plate in the volume of 2.5 µL, 5 µL, 7.5 µL and 10 µL. Similarly, the test sample was lay down and Allow the spots to dry and evolve the chromatogram in an unsaturated chamber containing a solvent system consisting of a mixture of chloroform, acetone and isopropyl alcohol (85: 10: 5) as late as the solvent front has moved not less than 15 cm from the origin. Pull out the plate from the developing chamber, mark the solvent from and allow the plate to air-dry. Locate the spots on the plate by examination under UV light at 365 nm.

Pesticide Residue Anlysis[10,11]

Extraction

Test sample were extracted with acetone and followed by homogenization for brief period. Further filtration was permitted and subsequent inclusion of acetone to the test mixture. Heating of test sample was carry out by using a rotary evaporator at a temperature not exceeding 40ºC until the solvent has nearly completely vaporized. To the residue add a few ml of toluene and heat again until the acetone is completely eliminated. Resultant residue was liquefy using toluene and filtered through membrane filter.

Sterility Test By Pour Plate Method

Methodology

Test sample was injected in sterile petri dish to which about 15 mL of molten agar 45ºC were added. Agar and sample were assorted thoroughly by tilting and swirling the dish. Agar was permitted to completely gel without disturbing it. (about10 minutes). Plates were then upturn and incubated at 37º for 24-48 hours and further expanded for 72 hours for fungal growth observation. Grown colonies of organism was then counted and calculated for CFU.

OBSERVATIONS AND RESULTS

Organoleptic characters of *NelliMulliIlagam* for various sensory characters like colour, taste, odour, etc… were carefully noted and the interpretation illustrated in Table 1 & (Figure 1). In solubility profile, NM Ilagam was soluble in Ethanol, water and DMSO and Insoluble in Chloroform, Ethyl acetate (Table 2). In physiochemical analysis, PH value, Ash value, alcohol soluble extractive value, loss on drying were noted in table 3. In test for specific pathogens, No growth was observed/ after incubation period. It reveals the absence of specific pathogen. (Table 4 &5) and No growth / colonies were observed in any of the plates inoculated with the test sample (Figure 2). In Phytochemical analysis, alkaloids, tannins, saponins, flavonoids, glycosides, coumarins, phenols, steroids, triterpenoids, Anthocyanin, carbohydrates, proteins were present. (Table 6 & Figure 3).In TLC Visualization of NMI at 366 nm was noted in Figure 4. In HPTLC finger printing analysis of the sample reveals the presence of four prominent peaks corresponds to the presence of four versatile phytocomponents present with in it. Rf value of the peaks ranges from 0.01 to 0.31.(Table 7) (Figure5 & 7).Results of the present investigation have clearly shows that the sample has no traces of heavy metals such as Lead, Arsenic and Cadmium, whereas the sample shows the presence of Mercury at 0.21 ppm (Table 8). In analysis of Aflatoxin,the results shown that there were no spots were being identified in the test sample loaded on TLC plates when compare to the standard which indicates that the sample were free from Aflatoxin B1, Aflatoxin B2, Aflatoxin G1, Aflatoxin G2(Table 9). In pesticide analysis, the results showed that there were no traces of pesticides residues such as Organo chlorine, Organo phosphorus, Organocarbamates and pyrethroids in the sample provided for analysis (Table 10). In sterility test**,** No growth / colonies were observed in any of the plates inoculates with the test sample (Table 11) (Figure 6).

CONCLUSION

In the current scenario drug standardization is vital for even centuries old traditional Siddha formulations for its global acclimatization. Evaluation of parameters such as ash value, loss on drying, TLC and HPTLC studies are determined, which signifies standard parameters to ensure the purity and quality of the drug. Preliminary phytochemical analysis is shown that the presence of alkaloids, tannins, saponins, flavonoids, glycosides, coumarins, phenols, steroids, triterpenoids, Anthocyanin, carbohydrates, proteins. The results were shown that the specified drug is containing various phytochemicals and is free from microbial contamination and pesticide residue**.** The heavy metals such as Arsenic, Cadmium, and Lead are occurs in below detection limit (BDL) and safe for consumption and Mercury at 0.21 PPM may be less than the recommended limit. The present study concludes that standardization of *NelliMulliIlagam* have exhibited significant results. And *NelliMulliIlagam* was moved its safety over the defined standardization method.

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Table 1: Organoleptic parameters of Nelli MulliIlagam

State	Semi solid
Odour	Strongly Aromatic
Touch	Greasy
Flow Property	Non free flowing
Appearance	Dark Brownish

Table 2:Solubility Profile

S.No	Solvent Used	Solubility / Dispersibility
1	Chloroform	Insoluble
2	Ethanol	Soluble
3	Water	Soluble
4	Ethyl acetate	Insoluble
5	DMSO	Soluble

Table 3: Physicochemical interpretation results

S.No	Parameter	Mean (n=3) SD
1	**Loss on Drying at 105 °C (%)**	21.6 ± 1.513
2	**Total Ash (%)**	0.7067 ± 0.125
3	**Acid insoluble Ash (%)**	0.07 ± 0.02
4	**Water soluble Extractive (%)**	8.3 ± 1.609
5	**Alcohol Soluble Extractive (%)**	14.4 ± 0.2646

Table 4: Detail of Specific Medium and their abbreviation

Organism	Abbreviation	Medium
E-coli	***EC***	***EMB Agar***
Salmonella	***SA***	***Deoxycholate agar***
Staphylococcus Aureus	***ST***	***Mannitol salt agar***
Pseudomonas Aeruginosa	***PS***	***Cetrimide Agar***

Table 5: Interpretation of microbial load results

Organism	Specification	Result	Method
E-coli	Absent	Absent	As per AYUSH specification
Salmonella	Absent	Absent	
Staphylococcus Aureus	Absent	Absent	
Staphylococcus Aureus	Absent	Absent	

Table 6:Phytochemico Analytical Report

S.NO	TEST	OBSEVATIONS
1	Alkaloids	+
2	Flavanoids	+
3	Glycosides	-
4	Steroids	+
5	Triterpenoids	+
6	Coumarin	-
7	Phenol	+
8	Tanin	+

9	Protein	+
10	Saponins	-
11	Sugar	-
12	Anthocyanin	-
13	Betacyanin	-

Table 7: Peak Table

Peak	Start Rf	Start Height	Max Rf	Max Height	Max %	End Rf	End Height	Area	Area %
1	0.01	1.6	0.02	103.2	11.75	0.04	9.2	692.7	10.70
2	0.04	36.3	0.06	626.5	71.38	0.08	0.0	4972.4	76.82
3	0.10	0.0	0.11	51.4	5.86	0.13	0.0	179.4	2.77
4	0.31	0.0	0.32	98.6	11.01	0.34	0.0	628.4	9.71

Table 8: Interpretation of Heavy metal analysis

Name of the Heavy Metal	Absorption Max Λ max	Result Analysis	Maximum Limit
Lead	217.0 nm	BDL	10 ppm
Arsenic	193.7 nm	BDL	3 ppm
Cadmium	228.8 nm	BDL	0.3 ppm
Mercury	253.7 nm	0.21 PPM	1 ppm

BDL : Below Detection Limit

Table 9: Interpretation of Aflatoxin Analysis

Aflatoxin	Sample NMI	AYUSH Specification Limit
B1	Not Detected - Absent	0.5 ppm
B2	Not Detected - Absent	0.1 ppm
G1	Not Detected - Absent	0.5 ppm
G2	Not Detected - Absent	0.1 ppm

Table 10: Test Result Analysis of the Sample NMI

Pesticide Residue / I.Organo Chlorine Pesticides	Sample NMI	AYUSH Limit (mg/kg)
Alpha BHC	BQL	0.1mg/kg
Beta BHC	BQL	0.1mg/kg
Gamma BHC	BQL	0.1mg/kg
Delta BHC	BQL	0.1mg/kg
DDT	BQL	1mg/kg
Endosulphan	BQL	3 mg/kg
II.Organo Phosphorus Pesticides		
Malathion	BQL	1mg/kg
Chlorpyriphos	BQL	0.2 mg/kg
Dichlorovos	BQL	1mg/kg
III. Organocarbamates		
Carbofuran	BQL	0.1 mg/kg
IV.Pyrethroid		
Cypermethrin	BQL	1mg/kg

BQL- Below Quantification Limit

Table 11: Interpretation of sterility test

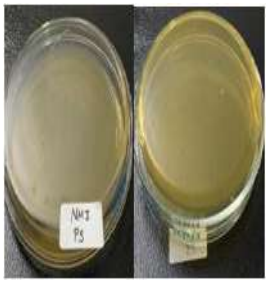
Test	Result	Specification	As per AYUSH/WHO
Total Bacterial Count	Absent	NMT 10^5CFU/g	As per AYUSH specification
Total Fungal Count	Absent	NMT 10^3CFU/g	

Figure :1 Organoleptic parameters of *NelliMullilIagam*

Culture plate with *E-coli* (EC) specific medium

Culture plate with *Salmonella* (SA) specific medium

Culture plate with *Staphylococcus Aureus* (ST) specific medium



Culture plate with *Pseudomonas aeruginosa* (PS) specific medium

Figure 2: Culture plate with *E-coli* (EC) specific medium

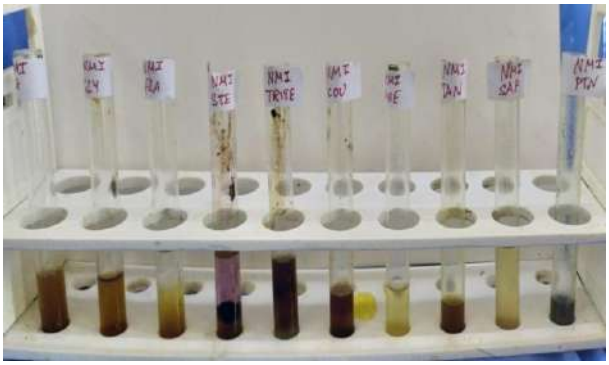


Figure 3: Qualitative Phytochemical Investigation

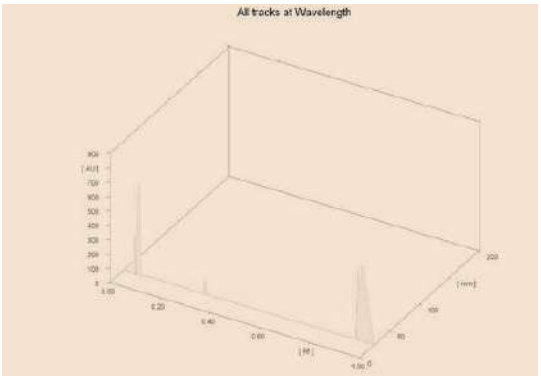


Figure 4: TLC Visualization of NMI at 366 nm3D – Chromatogram

Figure 5: HPTLC finger printing of Sample NMI

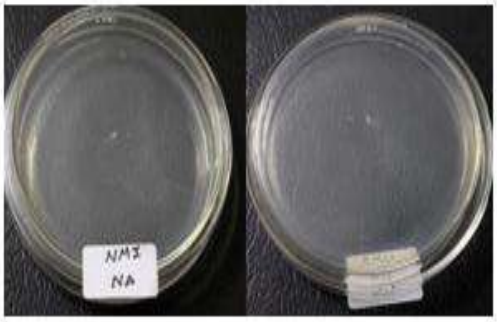


Figure 6: Interpretation of sterility test

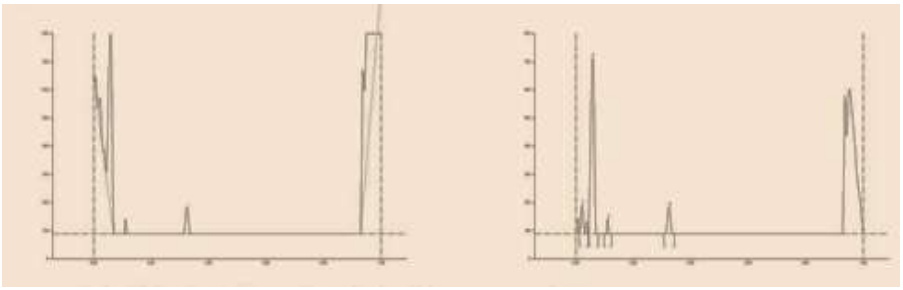


Table 7: Peak Table

RESEARCH ARTICLE

Naturalistic Intelligence and Environmental Awareness of Post Graduate Students of Assam Don Bosco University (ADBU): Guwahati

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ABSTRACT

The present paper looks into the Naturalistic Intelligence and Environmental Awareness of PG students of Assam Don Bosco University- Guwahati in terms of gender, department and also the relationship between them. Following the descriptive survey method data was collected from a sample of 115 students that were selected by adopting the proportionately stratified random sampling technique. It is reported that overall the students possess good naturalistic intelligence but average environmental awareness. Gender differences exist in naturalistic intelligence, but no such difference is seen in environmental awareness. Further, differences exist on both naturalistic intelligence and environmental awareness with respect to departments. However the study reported a significant relationship between the naturalistic intelligence and environmental awareness of the PG students of ADBU.

Keywords: Environmental, Guwahati, naturalistic, Awareness, Assam

INTRODUCTION AND RATIONALE

Climate action is the 13th SDG Goal that proposes to support sustainable natural resource management. This requires individuals to be environmentally friendly, sensitive, conscious and concerned about conservation of flora and fauna. Making behavioural adjustments is potent to achieving this goal. In this context, tapping in the Naturalistic Intelligence of the students is important together with ensuring environmental awareness. And therefore, the researchers attempt to study the relationship between the naturalistic intelligence and environmental awareness

among the post-graduate students of Assam Don Bosco University. Intelligence is the key to adaptable behaviour. Naturalistic intelligence being one is responsible to determining one's responsible behaviour towards the environment. According to Bloom's Taxonomy of Cognitive Domain the foundation of all lower and higher order thinking skills is one's knowledge. In this context, ADBU has a course titled Environmental Science where it provides an opportunity for research to find out the level of environmental awareness among the students of ADBU. Looking into the interplay between one's knowledge and intelligence, it is important to look into the relationship between the naturalistic intelligence and environmental awareness among the PG students.

Objectives of the Study

1. To identify the overall naturalistic intelligence of PG students of ADBU
2. To find out the difference between the mean scores of PG male and female students with respect to naturalistic intelligence
3. To identify the overall environmental awareness of PG students of ADBU
4. To find out the difference between the mean scores of PG male and female students with respect to environmental awareness
5. To find out the difference of Naturalistic Intelligence and Environmental Awareness among the Post graduate students of Social Work, English, Education, Psychology, and Mass Com.
6. To find out the relationship between naturalistic intelligence and environmental awareness of PG students of ADBU

Hypotheses of the Study

For achieving the objectives 2, 4, 5, and 6 the following null-hypotheses have been formulated:

H_{01}: There is no significant difference between the mean scores of PG male and female students with respect to naturalistic intelligence.

H_{02}: There is no significant difference between the mean scores of PG male and female students with respect to environmental awareness

H_{03}: There is no significant difference between the mean scores of Naturalistic Intelligence and Environmental awareness in the male and female students with respect to the departments (Social Work, Psychology, English, Education and mass com).

H_{04}: There is no significant relationship between naturalistic intelligence and environmental awareness of PG students of ADBU.

Delimitations of the Study

The study was delimited to:

1. PG Students of ADBU
2. The School of Humanities and Social Science
3. The 4th semester PG students of English, Education, Psychology, Mass Com and Social Work
4. Physical environment: land, water and air.

METHOD

Here, the descriptive survey method was adopted since the purpose of the study was to bring to light the prevailing status with respect to the psychological phenomenon at hand.

Research Design

The cross- sectional research design was adopted since data was collected from the field in one go.

Variables
Independent: Gender & Departments
Dependent: Naturalistic Intelligence & Environmental Awareness

Population
Only 4th semester PG students of the School of Humanities & Social Sciences-ADBU have been identified as the population for the present study. There are eight Departments under the School of Humanities and Social Sciences: Education, Mass Communication, Social Work, English, Psychology, Public Administration, Philosophy and Economics. The total population for the present study is 162. This excludes the departments of Economics, Philosophy and Public Administration since they have just started and do not have 4th semester students. Table 1 provides the distribution of the population on the basis of Department and gender.

Sampling and Sample
The researcher used stratified random sampling which is one method of Probability Sampling (Kombo and Tromp, 2006) to divide the student population into homogeneous subgroups and then took simple random sample from each subgroup. All the five departments formed the sample for the present study. However, regarding the students by applying the Yamen's formula the size of the sample has been fixed as 115. Further applying the proportionate stratified random sampling technique, the sample for the present study is presented in Table 2.

Tools used in the Study
In the present study, the investigator will use the following tools:
1. Naturalistic Intelligence Scale - NIS (prepared by P. Karpagam & M. Kanmani, 2014)
2. Environmental Awareness Scale – EAS (prepared by P. Karpagam, & M. Kanmani, 2014)

RESULTS AND DISCUSSION

Table 3 shows the computed mean score on the Naturalistic Intelligence of the PG students is 158.5 which is much higher than the mean score of the Naturalistic intelligence Scale (114). This indicates that the PG- ADBU students have good naturalistic intelligence. Further, Tale 4 shows majority students (65.2 %) have average level of naturalistic intelligence. Only 33.9 % of PG students have high level of naturalistic intelligence and only 1 student has low level of naturalistic intelligence. Table 5 and Fig. 2 inform us that the high scorers have homogeneously scored high on all the dimensions. Whereas the average scorers have scored average marks and the low scores have fared poorly in all the five dimensions of the naturalistic intelligence scale. Table 6 and Fig. 3 reveal that significant difference exists between the mean scores of PG male and female students with respect to their naturalistic intelligence. From Table 6 it is evident that the computed t value 61.3 is much greater than the table t value 1.98 at 0.05 level of significance for 113 df and has been considered significant. Further Table 6 and Fig. 3 show that the male mean score on Naturalistic intelligence is much greater (178.3) in comparison to the female mean score on Naturalistic intelligence (150.7). **Neto (2008)** too reported that there were sex differences in estimated naturalistic intelligence quotient. Table 7 shows the computed awareness mean score of the PG students (39.66) was much higher than the mean score (23.5) of the Environmental Awareness scale. This shows that the PG students of ADBU have good environmental awareness. From Table 8 and Fig. 4 it can be inferred that maximum number of students (49.6 %) has average level of environmental awareness. 41.5 % of PG students have high and only 13.9% students have low level of environmental awareness. Similar findings was reported by Sadhu & Dhillion (2005)[1], Mishra (2006)[2], Chandrashekar (2008)[3], Sarojini, K. (2010)[4], Kang & Chawla (2011)[5], and Marak (2013)[6] who studied the environmental awareness among secondary school students and found their level to be average as well.

Table 9 and Fig. 5 clearly demonstrate that the high scorers have scored greater mean value on environmental values, whereas the mean value (12.2) of low scores is greater than the mean value of the average scorers (11.7), though negligible. On the Skill dimension much variation in the mean scores of the high (9.8) and average (9.6) scorers is not

visible. The low scorers mean value is found to be 8. Similar trend is seen on the dimension of knowledge where the mean values of high (8.2) and average (8.03) scorers do not vary much from each other. However the mean score of the low achievers is very low in comparison (6.6). Though Table 10 and Fig.6 shows a difference in the mean scores of male and female PG students' environmental awareness, yet according to the 't' test this difference is not significant. Hence, the null hypothesis 'There will be no significant difference between the mean scores of PG male and female students with respect to their environmental awareness' is accepted. Similarly, the studies conducted by Mishra (2006)[2], Rout and Agarwal (2006)[8], Kaur & Kaur (2009)[9], and Shivkumar & Vamadevappa (2012)[10] too reported that no significant difference existed in the environmental awareness of male and female students. However, contrary findings were reported by Astalin (2011)[11] where male students expressed significantly more environmental awareness as compared to female students. On the contrary, Zafar (2002)[12], Surekha (2011)[13] and Marak (2013)[6] found that females were significantly more environmentally aware than the male students.

Table 11 reveals that a significant difference exists between the mean scores of naturalistic intelligence and environmental awareness with respect to the departments (Social Work, English, Education, Psychology, and Mass Communication). In Table 11 it is seen that the calculated 'F' 5.49 with df 4/110 is greater than the table value 2.46 and 2.44 at 0.05 level of significance, and hence significant. Similarly regarding the Environmental awareness the same can be implied from the Table No. 4.6 since the calculated 'F' 4.3 with df 4/110 is greater than the table value 2.46 at 0.05 level of significance, and hence significant. Though no direct studies were identified, yet, Thakur (2012)[14] conducted a study on environment awareness among senior secondary school students of Chandīgarh. The major findings of her study were that student of both government and private schools showed comparable environment awareness, science students exhibited very high degree of environment awareness to compare with the students of arts. Moreover, male science students exhibited very high degree of environment awareness than female science students but overall, no significant difference was found between male and female students in this context. To achieve Objective vi the researcher calculated the Pearson's correlation coefficient as 0.166. Computed r value 0.166 is greater than the table value 0.062 at 0.05 level for df 113. Therefore, the null hypothesis, 'There is no significant relationship between naturalistic intelligence and environmental awareness of PG students of ADBU' and the alternative hypothesis can be stated that 'There is a significant relationship between naturalistic intelligence and environmental awareness of PG students of ADBU'. Zarah (2018) too studied the relationship between naturalistic intelligence and environmental awareness of graduate students of University of Indonesia, and reported a strong and significant correlation between the naturalistic intelligence and environmental awareness with the value of coefficient correlation as 0.754.

CONCLUSION

The study revealed that the ADBU-PG students of the School of Humanities and Social Science had an average level of environmental awareness. In the light of this, the institution can take steps to make its Environmental Science curriculum more practical oriented where the scientific attitude of the students can be developed towards the environmental issues and problems. The gender differences in the mean scores on the naturalistic intelligence could be for the reason that boys are more engaged in outdoor activities whereas girls are indoor bound. This can provide more scope for outdoor activities to sensitize the students towards nature. In order to bring out a healthy and strong relationship between the naturalistic intelligence and environmental awareness, the 360 degree approach to evaluate the student's transformational progress as suggested by the NEP 2020 should be adopted by the university.

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Table: 1 Distribution of Population

DEPARTMENT	GENDER		TOTAL
	Male	Female	
Social Work	23	63	86
English	9	28	37
Education	2	3	5
Psychology	4	25	29
Mass com	3	2	5
Total	38	119	**162**

Table: 2 Sample Distribution

DEPARTMENT	GENDER		TOTAL
	Male	Female	
Social Work	16	44	60
English	6	20	26
Education	2	2	4
Psychology	3	18	21
Mass com	2	2	4
Total	**29**	**86**	**115**

Table: 3 Summary of Mean, SD, P33 and P66 of the overall Naturalistic intelligence of PG students of ADBU

Mean	SD	P 33	P 66
158.5	1.6	41.15	170.2

Table: 4 Overall Naturalistic Intelligence of PG Students of ADBU

Classification	Levels	No. Of students	Percentage
Above 170.2	High level of naturalistic intelligence	39	33.9%
42-169	Average level of naturalistic intelligence	75	65.2%
Below 41.15	Low level of naturalistic intelligence	1	0.9%

Table: 5 Summary of Means scored by PG students of ADBU on the five dimensions of the naturalistic intelligence scale

Levels of naturalistic intelligence	Admiration	Outdoor activities	Global warming	Biophilia	Scientific hobbies
High level of ni	34.5641	39.30769	33.33333	39.20513	39.38462
Average level of ni	27.2	30.76	23.49333	30.94667	29.98667
Low level of ni	7	8	7	8	8

Table: 6 Summary of Means, SD, SE_D, df and t-value of the Naturalistic intelligence scores of male and female PG students of ADBU

Groups	N	Mean	SD	SE_D	df	t-value	Significance
Male	**29**	178.3	**2.26**	**0.45**	**113**	**61.3**	**Highly significant at 0.05 level**
Female	**86**	150.7	**1.47**				

Table: 7 Summary of Mean, SD, P33rd and P66th of the overall environmental awareness of PG students of ADBU

Mean	SD	P 33	P 66
39.66	1.13	37.97	41.5

Table: 8 Overall environmental awareness of PG students of ADBU

Classification	Levels	No. of students	Percentage
Above 41.5	High level of environmental awareness	42	36.50%
38-41	Average level of environmental awareness	57	49.60%
Below 37.97	Low level of environmental awareness	16	13.90%

Table: 9 Summary of Means scored by PG students of ADBU on the four dimensions of the environmental awareness scale

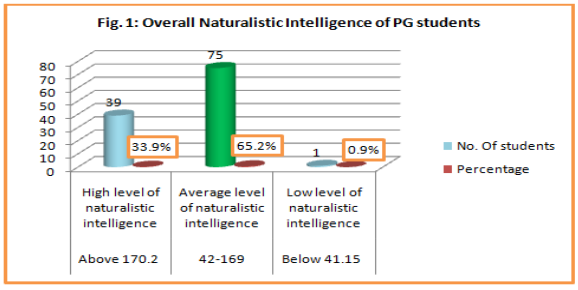
Levels	Personal cleanliness	Knowledge	Skill	Environmental values
High	9.404762	8.238095	9.833333	16.2381
Average	9.54386	8.035088	9.666667	11.70175
Low	7	6.6	8	12.2

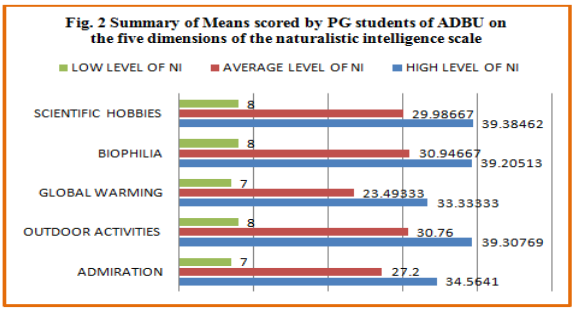
Table: 10 Summary of Means, SD, SED, df and t-value of the Naturalistic intelligence scores of male and female PG students of ADBU

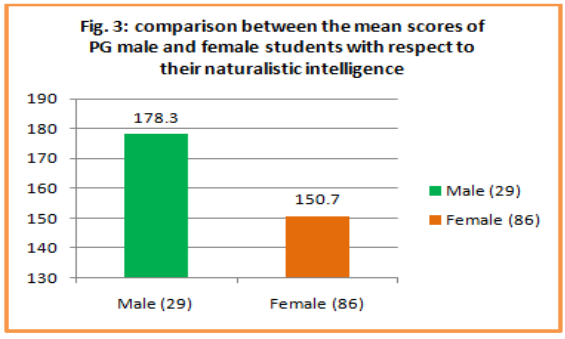
Groups	N	Mean	SD	SED	df	t-value	Significance
Male	**29**	40.1	**0.65**	**0.17**	**113**	**0.47**	**Not significant at 0.05 level**
Female	**86**	40.02	**1.165**				

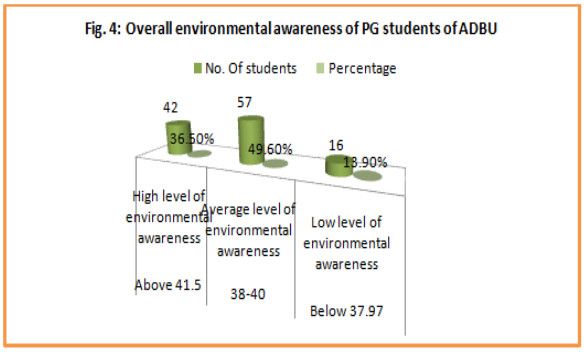
Table: 11 Department wise comparison of mean scores of naturalistic intelligence and environmental awareness of post graduate students

Variables	Stream	Sum of squares	df	Mean squares	F	Significance
Naturalistic intelligence	**Between groups**	15587.37	4	3896.8425	5.49	Highly significant at 0.05 level of significance
	Within groups	78024.91	110	709.3		
	Total	93612.28	114	4606.143		
Environmental Awareness	**Between groups**	201	4	50.25	4.3	Highly significant at 0.05 level of significance
	Within groups	1274.649	110	11.6		
	Total	1475.649	114	61.85		









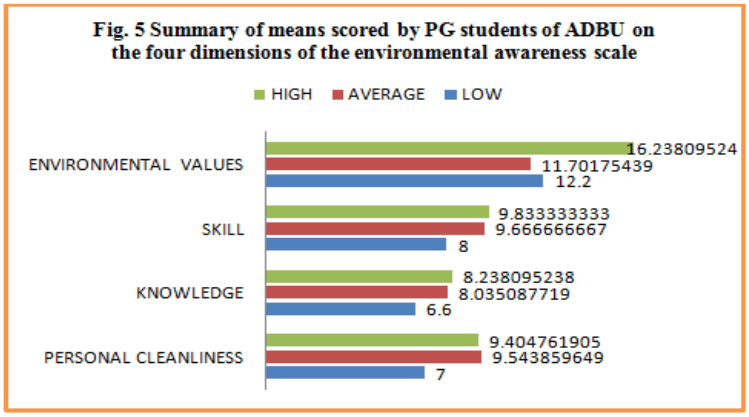


Fig. 5 Summary of means scored by PG students of ADBU on the four dimensions of the environmental awareness scale

RESEARCH ARTICLE

Smart Agricultural Management System using Big Data Analysis and Internet of Things

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ABSTRACT

The information provided by a smart agriculture management system varies depending on the crop. It automatically regulates numerous agricultural gadgets while also reducing agricultural manpower. Temperature sensor, humidity sensor, leaf sensor, GPS module, and image sensor are used in this study to collect various data on a specific crop in the agricultural area. These details are transferred to the CC3200 launch pad and subsequently saved in the cloud. The information is obtained from the cloud via an Android application and provided to the customer or farmers. The decision-making and prediction in this android framework are based on cloud data, which is analyzed utilizing ANN, fuzzy logic, and neuro fuzzy systems. Farmers will benefit greatly from the suggested method. The proposed method performance measured by the following parameters accuracy 89%, precision 87%, recall 85% and execution time 120 ms.

Keywords: sensor, CC3200 launch pad, ANN, fuzzy logic and neuro fuzzy system.

INTRODUCTION

Crop growth development, corporate farms, agricultural engineering, crop development section, harvesting and transportation, smart weighbridge, agricultural financials, agronomy, vehicle management, and farmer assistance portal are all examples of agriculture management systems (AMS). AMS provides detailed information on the crop as well as control measuring procedures for that crop [1]. It includes everything and even maintains track of the

numerous agricultural processes performed on the crop. It also contains advice on calculating amounts for various inputs like as pesticides, seed, harvesting schedule, support organization, fertilizer, and labor planning [2]. Agricultural inventory management systems are used to give agricultural statistics such as crop damage, production detection, seasonal monitoring, data mining services, and online up-to-date data warehouse [3]. Information and communication technology, big data analysis, internet of things, cloud computing, robots, artificial intelligence, and other technologies are all used in smart farming [4]. The communication between the processor and the sensor, as well as the processor and the client, is established using information and communication technology [5]. Big data analysis is utilized to give diverse crop information such as seed, variety, fertilizer, insecticides, and so on. We must forecast the future utilizing numerous big data analysis approaches based on this diverse data. IoT is a new technology that connects various kinds of devices to the cloud and processor, including temperature sensors, leaf sensors, image sensors, moisture sensors, humidity sensors, and so on [6]. Each device communicates with the cloud or processor via a wired or wireless link. Artificial intelligence is used to construct a hardware or software system model to maintain an agricultural management system in an effective manner employing robotic techniques such as automated irrigation, automatic fertilizer, and automatic diseases prevention and control systems, among others. For decision-making and prediction, artificial neural networks, fuzzy logic, and neuro fuzzy systems are commonly utilized [7].

METHODOLOGY

This research provides farmers with useful information as well as recommendations for numerous agricultural issues. This system gathers data from temperature sensors, humidity sensors, leaf sensors, a GPS module, an image sensor, wind flow sensors, and soil sensors, among other sensors. This data is stored in the CC3200 processor and then transferred to the cloud. The Android application pulls data from the cloud and sends it to agriculture producers or clients. The block diagram of proposed method is shown figure (1).

TEMPERATURE SENSORS

The LM 35 temperature sensor is linked to the CC3200 CPU. It's a temperature sensor with a precision integrated circuit. The output voltage is proportional to the temperature in Celsius [8]. The ambient air temperature and surface temperature are measured by this sensor. It can detect temperatures ranging from -55 to +150 degrees Celsius. Figure 2 shows the pin arrangement of the LM 35.

HUMIDITY SENSORS

The humidity sensor is a three-pin device, as shown in Figure (3). It is used to determine the moisture content and temperature of the air. The ratio of moisture in the air at a given temperature to the highest value of moisture at the same temperature is known as relative humidity [9]. Two electrodes are placed in the agricultural area to monitor humidity.

LEAF SENSORS

The water loss or water shortage stress in agricultural plant leaves is measured using a leaf sensor [10]. The automatic irrigation management system makes extensive use of this data. The automated watering system is turned on if the information value exceeds the threshold value; otherwise, it is turned off. Figure 4 shows the pin arrangement of a leaf sensor [11].

GPS MODULE

The GPS module is utilised to determine the current geographical position. The latitude and longitude data are used to denote the location. It is a gadget that can read information from a satellite [12]. When the GPS module is turned on, the latitude and longitude of the current geographical position are shown automatically. Figure 5 shows the GPS module pin arrangement .

IMAGE SENSOR

The image of the agricultural area was captured using an image sensor. It detects and transmits data and is used to create an image matrix [13]. In general, pictures are represented as matrices, with each member in the matrix being referred to as a pixel. Every pixel has a value, which spans from 0 to 255. It's a type of electronic imaging device that can store both analogue and digital data [14]. Figure 6 shows the image sensor pin layout with the CC3200. We are employing the image sensor MT9D111 camera module with the CC3200 launch pad in this research. The newest SDK Firmware Package software is required. This image sensor is capable of capturing QVGA images in JPEG format [15].

CC3200 LAUNCH PAD

The CC3200 Launch pad was created with internet of things applications in mind. It is a descendant of arm cortextm-m4. Wi-Fi capability and internet on a chip are two of the CC3200 launch pad's main features. The open source software Energia is used to programme the CC3200 launch pad and gear [16]. It offers the user with some basic default example programmes for various hardware applications; we may edit the current example programmes to meet our needs or create new ones. Figure 7 shows the text editor in the Energia software development environment. The hardware view of CC3200 shown in figure(8).

CLOUD

In this research work we are using IBM cloud [17]. The following steps are used to store the sensor's data or information to cloud as shown in figure 10.

1. Create a software to save sensor data in the cloud.
2. Join the IBM Watson Internet of Things platform. Service that begins immediately
3. Data visualization
4. Add your gadget to the Watson IoT platform.
5. Connecting to a registered device on the IBM Watson IoT platform

Android Application

To make an android application, you'll need the Android SDK tool. Home, Sensors, Prediction, Management System, and Other Information are the five key sections of the Android application. For decision-making and autonomous control of diverse devices, artificial neural networks (AN), fuzzy logic, and neuro fuzzy systems are employed. Figure 11 depicts the Android application framework . The java software is used to transfer data from the cloud to the android application, while the XML programme is used to construct the android frame layout [18]. The artificial neural network (ANN) is a supervised learning approach for classification and recognition. If-then rules are used in fuzzy logic to make decisions [19]. Neuro fuzzy method is a hybrid system. It is a combination of ANN and Fuzzy logic used for both classification and decision-making applications.

RESULT ANALYSIS

Three methodologies are used in the implementation of this suggested system: ANN, Fuzzy logic, and Neuro fuzzy system. The accuracy value is used to guide the evolution of the proposed system. Figure 12 to 15 and Table 1to 4 shows the compression graph for the suggested system. In this graph, the ANN technique outperforms the Fuzzy logic method in terms of accuracy [20]. When compared to ANN and fuzzy logic, the neuro fuzzy system produces better results.

CONCLUSION

Smart agriculture management system offers farmers with a wealth of helpful information and beneficial recommendations, and it can control and automate all other equipment connected to it. Each sensor is connected to the processor, and the sensor readings are saved in the cloud so that farmers can readily access all of the metrics

using an Android app. Farmers can minimise crop loss and possibly boost agricultural product yields if they discover the illness in the plant at an early stage. In this proposed method using the android application model makes everyone to access the information and is easier and faster. In future we are planning to implement the app in various local languages like Tamil, Hindi, Malayalam, Bengali.etc .This method provide above 85% of accuracy.

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Table 1: Performance Analysis based on accuracy

Sensors	Accuracy			
	MDC	ANN	Fuzzy	Neuro-Fuzzy
Temperature	65	71	78	89
Humidity	68	75	75	85
Leaf	65	76	76	86
Image	67	75	74	87

Table 2: Performance Analysis based on Recall

Sensors	Recall (%)			
	MDC	ANN	Fuzzy	Neuro-Fuzzy
Temperature	64	75	78	87
Humidity	65	71	76	89
Leaf	64	72	77	87
Image	64	71	78	82

Table 3: Performance Analysis based on Precision

Sensors	Precision (%)			
	MDC	ANN	Fuzzy	Neuro-Fuzzy
Temperature	61	74	77	84
Humidity	63	75	76	85
Leaf	64	75	77	86
Image	62	76	78	84

Table 4: Performance Analysis based on accuracy

Sensors	Execution time (ms)			
	MDC	ANN	Fuzzy	Neuro-Fuzzy
Temperature	321	256	190	120
Humidity	325	245	180	115
Leaf	362	235	178	123
Image	385	286	175	145

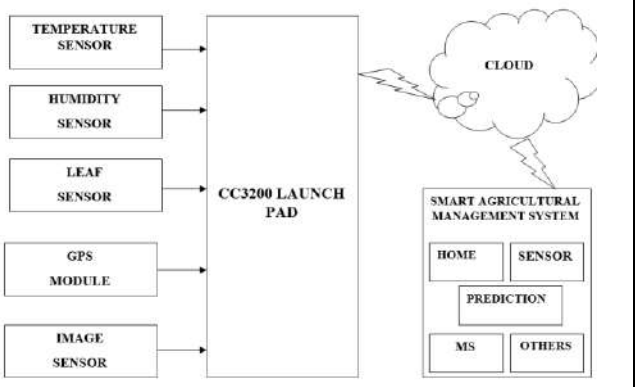

Figure 1: Block Diagram for proposed System

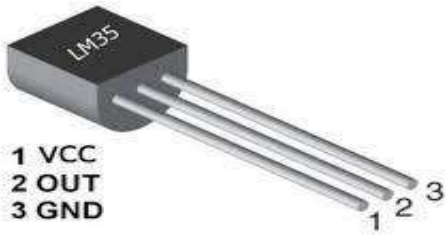

Figure 2: Temperature Sensor

Figure3: Humidity Sensor

Figure 4:Leaf Sensor

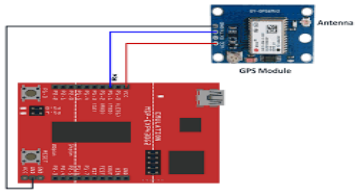

Figure 5 :GPS module

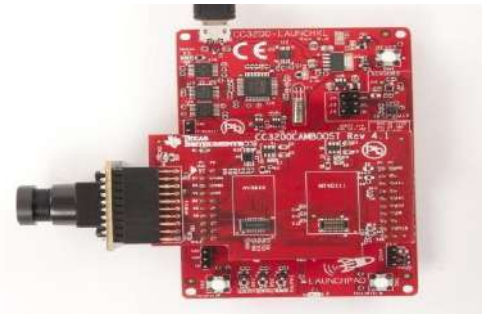

Figure 6: Image sensor

Figure 7: CC3200 Launch Pad

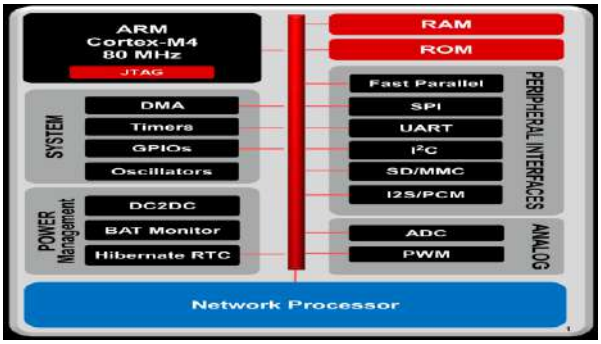

Figure 8: Hardware View of CC3200

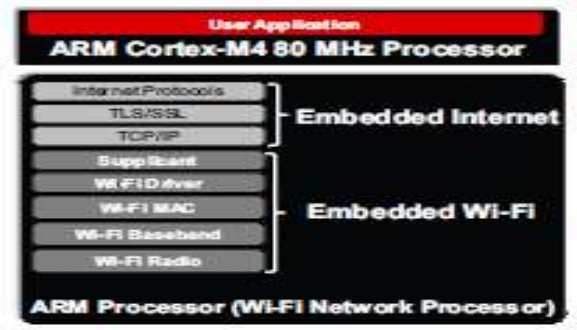

Fig 9: CC3200: the Software view of CC3200

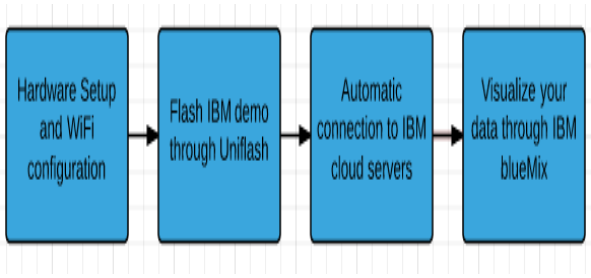

Figure 10. Cloud data storage

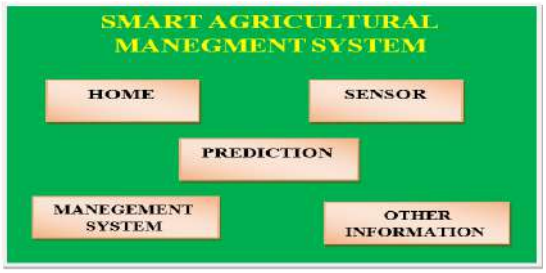

Figure11: Android Application Frame work

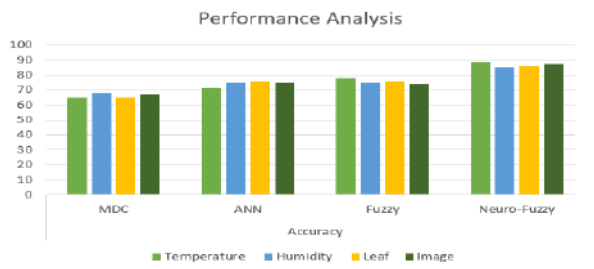

Figure 12: Performance Analysis based on accuracy

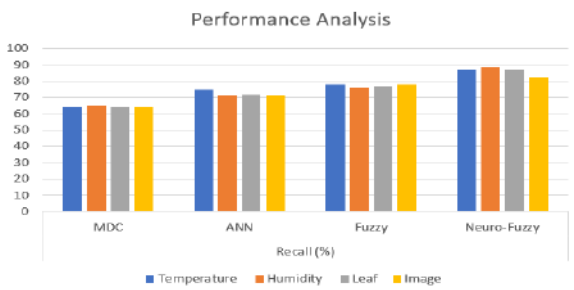

Figure 13: Performance Analysis based on Recall

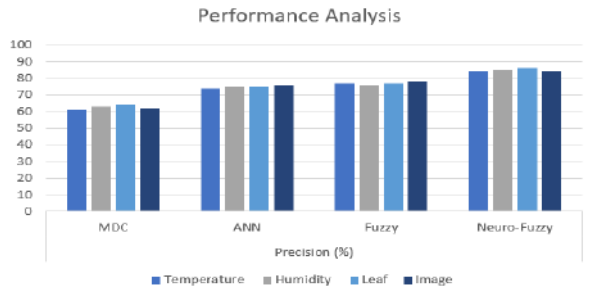

Figure 14: Performance Analysis based on precision

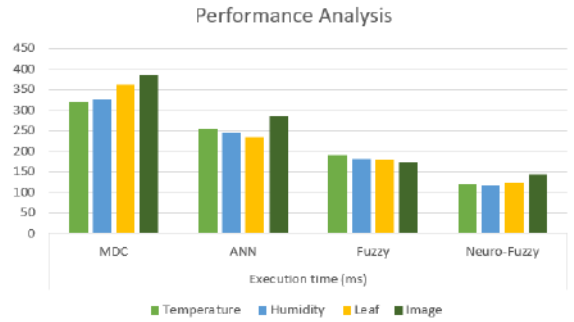

Figure 15: Performance Analysis based on Execution time

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RESEARCH ARTICLE

A New Power Ishita Distribution with Application in Medical Sciences

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ABSTRACT

In the present study, a new model of power Akash distribution has been introduced known as Length biased power Akash distribution. Various structural properties of the proposed distribution as moments, reliability measures, order statistics, Bonferroni and Lorenz curves have been presented and studied. The model parameters of this distribution are estimated by maximum likelihood estimator along with Fisher's information matrix. Finally, an application to real life two data sets are presented for illustrating the supremacy of a newly proposed model.

Keywords: Weighted distribution, Power Akash distribution, Reliability measures, Order statistics, Maximum likelihood estimator.

INTRODUCTION

The power Akash distribution introduced by Shanker and Shukla (2017) is a two parametric life-time model. The proposed power Akash distribution is a particular case of Akash distribution and the transformation $X = Y^{\frac{1}{\alpha}}$ is substituted in one parameter Akash distribution to obtain the power transformation of Akash distribution. Its important statistical properties including shapes of the density, hazard rate function, survival function, moments, skewness, kurtosis and stochastic ordering have been studied and presented. The method of maximum likelihood estimator have been discussed for estimating its parameters. Shanker discussed one parameter Akash distribution in (2015) obtain its various statistical properties and discuss its method of moments and maximum likelihood estimator

for estimating its parameters. Shanker and Shukla also discussed on two parameter Akash distribution in (2017) derive its various statistical properties, estimate its parameters through maximum likelihood estimator and method of moments and discuss its goodness of fit in analysing lifetime data. Shanker discussed quasi Akash distribution in (2016) studied its different statistical properties and estimate its parameters through maximum likelihood estimator and method of moments. Finally, the goodness of fit of power Akash distribution has been demonstrated and the fit has been found quite satisfactory over two parameter power lindley distribution and one parameter Akash, Lindley and exponential distributions.

The probability density function of power Akash distribution (PAD) is given by

$$f(x;\theta,\alpha)=\frac{\alpha\theta^3}{\left(\theta^2+2\right)}\left(1+x^{2\alpha}\right)x^{\alpha-1}e^{-\theta x^{\alpha}}\ ;\ x>0,\theta>0,\ \alpha>0 \qquad (1)$$

and the cumulative distribution function of power Akash distribution is given by

$$F(x;\theta,\alpha)=1-\left(1+\frac{\theta x^{\alpha}\left(\theta x^{\alpha}+2\right)}{\theta^2+2}\right)e^{-\theta x^{\alpha}}\ ;\ x>0,\theta>0,\alpha>0 \qquad (2)$$

Length Biased Power Akash Distribution (LBPAD)

Length biased distribution is a special case of weighted distributions. The concept of weighted distributions was first introduced by Fisher (1934) to model ascertainment bias, but these were later formalized in a unifying theory by Rao (1965). The weighted distributions arise when the observations generated from a stochastic process are not given equal chances of being recorded; instead they are recorded according to some weight function. When the weight function depends only on the length of units of interest, resulting distribution is called length biased. The statistical interpretation of length biased distribution was originally identified by Cox (1962) in the context of renewal theory. The concept of length biased sampling was introduced by Cox (1969) and Zelen (1974). Length biased sampling situation may occur in clinical trials, reliability theory, survival analysis and population studies were a proper sampling frame is absent. More generally, when the sampling mechanism selects units with probability proportional to measure of the unit size, resulting distribution is called size biased. Size biased distributions are a special case of the more general form known as weighted distributions. These distributions arise in practice when observations from a sample are recorded with unequal probability and provide unifying approach for the problems when the observations fall in the non-experimental, non-replicated and non-random categories. Van Deusen (1986) arrived at size biased distribution theory independently and applied it to fitting distributions of diameter at breast height (DBH) data arising from horizontal point sampling (HPS) (Grosenbaugh) inventories. Subsequently, Lappi and Bailey (1987) used weighted distributions to analyse HPS diameter increment data. Dennis and Patil (1984) used stochastic differential equations to arrive at a weighted gamma distribution as the stationary probability density function (PDF) for the stochastic population model with predation effects. Rather and Ozel (2021) studied length biased power Lindley distribution with properties and applications. Reyad et al. (2017) introduced the length biased weighted frechet distribution with properties and estimation. Das and Roy (2011) pointed out the length biased weighted generalized Rayleigh distribution and studied its properties. Shaban and Boudrissa (2007) presented the length biased weibull distribution and estimated its parameters. Mir et al. (2013) discussed on the size biased Exponential distribution. Ganaie and Rajagopalan (2021) pointed out length biased weighted new quasi Lindley distribution with statistical properties and its applications. Andure and Ade (2021) studied the length biased quasi Lindley distribution and its applications. Afaq et al. (2016) discussed on the length biased Lomax distribution and studied its various statistical properties. Alidamat and Al-omari (2021) executed the length biased two parameter Mirra distribution with an application to engineering data. Al-omari et al.(2019) studied size-biased Ishita distribution. Al-omari and Alsmairan (2019) derived length biased Suja distribution. Ahmed et al. (2013) studied size-biased gamma distribution. Reyad et al. (2017) presented length biased weighted erlang distribution. Recently, Ganaie and Rajagopalan (2021) pointed out the length biased power quasi Lindley distribution with applications which shows more flexible than the classical distribution.

Let the random variable *X* of non-negative condition has probability density function $f(x)$ .Let its non-negative weight function be *w(x)*then, the probability density function of weighted random variable X_w is given by

$$f_w(x) = \frac{w(x) f(x)}{E(w(x))}, \quad x > 0.$$

$$\text{assuming that } E(w(x)) = \int w(x) f(x) dx < \infty. \text{ i.e. the first moment of } w(x) \text{ exists.}$$

Depending upon the choice of weight function *w(x)* weighted models are of different types. Clearly when $w(x) = x^c$, resulting distribution is called weighted distribution. In this paper, we have to obtain the length biased version of power Akash distribution. Consequently for $w(x) = x$, the resulting distribution is called length biased distribution with probability density function given by

$$f_l(x) = \frac{x f(x)}{E(x)} \tag{3}$$

Where $E(x) = \int_0^\infty x f(x) dx$

$$E(x) = \frac{\theta^2 \Gamma \frac{(\alpha+1)}{\alpha} + \Gamma \frac{(3\alpha+1)}{\alpha}}{\alpha \theta^{\frac{1}{\alpha}} (\theta^2 + 2)} \tag{4}$$

Substitute equations (1) and (4) in equation (3), we will obtain the probability density function of length biased power Akash distribution.

$$f_l(x) = \frac{\alpha \theta^{\frac{3\alpha+1}{\alpha}}}{\left(\theta^2 \Gamma \frac{(\alpha+1)}{\alpha} + \Gamma \frac{(3\alpha+1)}{\alpha} \right)} x^\alpha \left(1 + x^{2\alpha}\right) e^{-\theta x^\alpha} \tag{5}$$

and the cumulative distribution function of length biased power Akash distribution can be obtained as

$$F_l(x) = \int_0^x f_l(x) dx$$

$$F_l(x) = \int_0^x \frac{\alpha \theta^{\frac{3\alpha+1}{\alpha}}}{\left(\theta^2 \Gamma \frac{(\alpha+1)}{\alpha} + \Gamma \frac{(3\alpha+1)}{\alpha} \right)} x^\alpha \left(1 + x^{2\alpha}\right) e^{-\theta x^\alpha} dx$$

$$F_l(x) = \frac{1}{\left(\theta^2 \Gamma \frac{(\alpha+1)}{\alpha} + \Gamma \frac{(3\alpha+1)}{\alpha} \right)} \int_0^x \alpha \theta^{\frac{3\alpha+1}{\alpha}} x^\alpha \left(1 + x^{2\alpha}\right) e^{-\theta x^\alpha} dx$$

$$F_l(x) = \frac{1}{\theta^2 \Gamma \frac{(\alpha+1)}{\alpha} + \Gamma \frac{(3\alpha+1)}{\alpha}} \left(\alpha \theta^{\frac{3\alpha+1}{\alpha}} \int_0^x x^\alpha e^{-\theta x^\alpha} dx + \alpha \theta^{\frac{3\alpha+1}{\alpha}} \int_0^x x^{3\alpha} e^{-\theta x^\alpha} dx \right) \tag{6}$$

$$\text{Put } \theta x^{\alpha} = t \qquad \Rightarrow x^{\alpha} = \frac{t}{\theta} \qquad \Rightarrow x = \left(\frac{t}{\theta}\right)^{\frac{1}{\alpha}}$$

$$\text{Also } \alpha\theta x^{\alpha-1}dx = dt \qquad \Rightarrow dx = \frac{dt}{\alpha\theta x^{\alpha-1}} \qquad \Rightarrow dx = \frac{dt}{\alpha\theta\left(\frac{t}{\theta}\right)^{\frac{\alpha-1}{\alpha}}}$$

After the simplification of equation (6), we will obtain the cumulative distribution function of length biased power Akash distribution as

$$F_l(x) = \frac{1}{\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha} + \Gamma\frac{(3\alpha+1)}{\alpha}\right)}\left(\theta^2\gamma\left(\frac{(\alpha+1)}{\alpha}, \theta x^{\alpha}\right) + \gamma\left(\frac{(3\alpha+1)}{\alpha}, \theta x^{\alpha}\right)\right) \qquad (7)$$

Reliability Measures

In this section, we will discuss the survival function, hazard rate and reverse hazard rate functions of the proposed length biased power Akash distribution.

Survival function

The survival or reliability function of length biased power Akash distribution is given by

$$S(x) = 1 - F_l(x)$$

$$S(x) = 1 - \frac{1}{\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha} + \Gamma\frac{(3\alpha+1)}{\alpha}\right)}\left(\theta^2\gamma\left(\frac{(\alpha+1)}{\alpha}, \theta x^{\alpha}\right) + \gamma\left(\frac{(3\alpha+1)}{\alpha}, \theta x^{\alpha}\right)\right)$$

Hazard function

The hazard function is also known as instantaneous failure rate or force of mortality is given by

$$h(x) = \frac{f_l(x)}{1 - F_l(x)}$$

$$h(x) = \frac{\alpha\theta^{\frac{3\alpha+1}{\alpha}} x^{\alpha}\left(1 + x^{2\alpha}\right)e^{-\theta x^{\alpha}}}{\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha} + \Gamma\frac{(3\alpha+1)}{\alpha}\right) - \left(\theta^2\gamma\left(\frac{(\alpha+1)}{\alpha}, \theta x^{\alpha}\right) + \gamma\left(\frac{(3\alpha+1)}{\alpha}, \theta x^{\alpha}\right)\right)}$$

Reverse hazard function

The reverse hazard function is given by

$$h_r(x) = \frac{f_l(x)}{F_l(x)}$$

$$h_r(x) = \frac{\alpha\theta^{\frac{3\alpha+1}{\alpha}} x^{\alpha}\left(1+x^{2\alpha}\right)e^{-\theta x^{\alpha}}}{\left(\theta^2\gamma\left(\frac{(\alpha+1)}{\alpha},\theta x^{\alpha}\right)+\gamma\left(\frac{(3\alpha+1)}{\alpha},\theta x^{\alpha}\right)\right)}$$

Structural Properties

In this section, we will discuss various structural properties of length biased power Akash distribution.

Moments

Let the random variable X following length biased power Akash distribution with parametersθ and α, then the r^{th} order moment $E(X^r)$ of X about origin is

$$E(X^r) = \mu_r' = \int_0^{\infty} x^r f_l(x)dx$$

$$E(X^r) = \int_0^{\infty} \frac{\alpha\theta^{\frac{3\alpha+1}{\alpha}}}{\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}\right)} x^{\alpha+r}\left(1+x^{2\alpha}\right)e^{-\theta x^{\alpha}}\,dx$$

$$E(X^r) = \frac{\alpha\theta^{\frac{3\alpha+1}{\alpha}}}{\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}\right)} \int_0^{\infty} x^{\alpha+r}\left(1+x^{2\alpha}\right)e^{-\theta x^{\alpha}}\,dx$$

$$E(X^r) = \frac{\alpha\theta^{\frac{3\alpha+1}{\alpha}}}{\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}\right)}\left(\int_0^{\infty} x^{\alpha+r}e^{-\theta x^{\alpha}}dx + \int_0^{\infty} x^{3\alpha+r}e^{-\theta x^{\alpha}}dx\right) \qquad (8)$$

$$\text{Put } x^{\alpha} = t \quad \Rightarrow x = t^{\frac{1}{\alpha}}$$

$$\text{Also } \alpha x^{\alpha-1}dx = dt \quad \Rightarrow dx = \frac{dt}{\alpha x^{\alpha-1}} \quad \Rightarrow dx = \frac{dt}{\alpha t^{\frac{\alpha-1}{\alpha}}}$$

After simplification equation (8) becomes

$$E(X^r) = \mu_r' = \frac{\theta^2\Gamma\frac{(\alpha+r+1)}{\alpha}+\Gamma\frac{(3\alpha+r+1)}{\alpha}}{\alpha\theta^{\frac{r}{\alpha}}\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}\right)} \qquad (9)$$

By putting r= 1, 2, 3 and 4 in equation (9), we will get the first four moments of length biased power Akash distribution.

$$E(X) = \mu_1' = \frac{\theta^2\Gamma\frac{(\alpha+2)}{\alpha} + \Gamma\frac{(3\alpha+2)}{\alpha}}{\alpha\theta^{\frac{1}{\alpha}}\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha} + \Gamma\frac{(3\alpha+1)}{\alpha}\right)}$$

$$E(X^2) = \mu_2' = \frac{\theta^2\Gamma\frac{(\alpha+3)}{\alpha} + \Gamma\frac{(3\alpha+3)}{\alpha}}{\alpha\theta^{\frac{2}{\alpha}}\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha} + \Gamma\frac{(3\alpha+1)}{\alpha}\right)}$$

$$E(X^3) = \mu_3' = \frac{\theta^2\Gamma\frac{(\alpha+4)}{\alpha} + \Gamma\frac{(3\alpha+4)}{\alpha}}{\alpha\theta^{\frac{3}{\alpha}}\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha} + \Gamma\frac{(3\alpha+1)}{\alpha}\right)}$$

$$E(X^4) = \mu_4' = \frac{\theta^2\Gamma\frac{(\alpha+5)}{\alpha} + \Gamma\frac{(3\alpha+5)}{\alpha}}{\alpha\theta^{\frac{4}{\alpha}}\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha} + \Gamma\frac{(3\alpha+1)}{\alpha}\right)}$$

$$\text{Variance} = \frac{\theta^2\Gamma\frac{(\alpha+3)}{\alpha} + \Gamma\frac{(3\alpha+3)}{\alpha}}{\alpha\theta^{\frac{2}{\alpha}}\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha} + \Gamma\frac{(3\alpha+1)}{\alpha}\right)} - \left(\frac{\theta^2\Gamma\frac{(\alpha+2)}{\alpha} + \Gamma\frac{(3\alpha+2)}{\alpha}}{\alpha\theta^{\frac{1}{\alpha}}\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha} + \Gamma\frac{(3\alpha+1)}{\alpha}\right)}\right)^2$$

$$S.D(\sigma) = \sqrt{\left(\frac{\theta^2\Gamma\frac{(\alpha+3)}{\alpha} + \Gamma\frac{(3\alpha+3)}{\alpha}}{\alpha\theta^{\frac{2}{\alpha}}\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha} + \Gamma\frac{(3\alpha+1)}{\alpha}\right)} - \left(\frac{\theta^2\Gamma\frac{(\alpha+2)}{\alpha} + \Gamma\frac{(3\alpha+2)}{\alpha}}{\alpha\theta^{\frac{1}{\alpha}}\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha} + \Gamma\frac{(3\alpha+1)}{\alpha}\right)}\right)^2\right)}$$

Harmonic mean

The harmonic mean for the proposed model can be obtained as

$$H.M = E\left(\frac{1}{x}\right) = \int_0^\infty \frac{1}{x} f_l(x)dx$$

$$H.M = \int_0^{\infty} \frac{\alpha\theta^{\frac{3\alpha+1}{\alpha}}}{\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}\right)} x^{\alpha-1}\left(1+x^{2\alpha}\right)e^{-\theta x^{\alpha}}\,dx$$

$$H.M = \frac{\alpha\theta^{\frac{3\alpha+1}{\alpha}}}{\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}\right)} \int_0^{\infty} x^{\alpha-1}\left(1+x^{2\alpha}\right)e^{-\theta x^{\alpha}}\,dx$$

$$H.M = \frac{\alpha\theta^{\frac{3\alpha+1}{\alpha}}}{\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}\right)}\left(\int_0^{\infty} x^{\alpha-1}\,e^{-\theta x^{\alpha}}\,dx+\int_0^{\infty} x^{3\alpha-1}\,e^{-\theta x^{\alpha}}\,dx\right) \qquad (10)$$

$$\text{Put } x^{\alpha}=t \quad \Rightarrow x=t^{\frac{1}{\alpha}}$$

$$\text{Also } \alpha x^{\alpha-1}dx=dt \quad \Rightarrow dx=\frac{dt}{\alpha x^{\alpha-1}} \quad \Rightarrow dx=\frac{dt}{\alpha t^{\frac{\alpha-1}{\alpha}}}$$

After simplification of equation (10), we obtain

$$H.M = \frac{\theta^{\frac{3\alpha+1}{\alpha}}}{\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}\right)}\left(\gamma\left(1,\,\theta x^{\alpha}\right)+\gamma\left(3,\,\theta x^{\alpha}\right)\right)$$

Moment Generating Function and Characteristic Function

Suppose the random variable X following length biased power Akash distribution, then the moment generating function of X can be obtained as

$$M_X(t)=E\left(e^{tx}\right)=\int_0^{\infty} e^{tx} f_l(x)dx$$

Using Taylor's series, we obtain

$$M_X(t)=\int_0^{\infty}\left(1+tx+\frac{(tx)^2}{2!}+....\right)f_l(x)dx$$

$$M_X(t)=\int_0^{\infty}\sum_{j=0}^{\infty}\frac{t^j}{j!}x^j\,f_l(x)dx$$

$$M_X(t)=\sum_{j=0}^{\infty}\frac{t^j}{j!}\mu_j'$$

$$M_X(t) = \sum_{j=0}^{\infty} \frac{t^j}{j!} \left(\frac{\theta^2 \Gamma \frac{(\alpha + j + 1)}{\alpha} + \Gamma \frac{(3\alpha + j + 1)}{\alpha}}{\alpha \theta^{\frac{j}{\alpha}} \left(\theta^2 \Gamma \frac{(\alpha + 1)}{\alpha} + \Gamma \frac{(3\alpha + 1)}{\alpha} \right)} \right)$$

$$M_X(t) = \frac{1}{\alpha \left(\theta^2 \Gamma \frac{(\alpha + 1)}{\alpha} + \Gamma \frac{(3\alpha + 1)}{\alpha} \right)} \sum_{j=0}^{\infty} \frac{t^j}{j! \theta^{\frac{j}{\alpha}}} \left(\theta^2 \Gamma \frac{(\alpha + j + 1)}{\alpha} + \Gamma \frac{(3\alpha + j + 1)}{\alpha} \right)$$

Similarly,the characteristic function of length biased power Akash distribution can be obtained as

$$M_X(it) = \frac{1}{\alpha \left(\theta^2 \Gamma \frac{(\alpha + 1)}{\alpha} + \Gamma \frac{(3\alpha + 1)}{\alpha} \right)} \sum_{j=0}^{\infty} \frac{it^j}{j! \theta^{\frac{j}{\alpha}}} \left(\theta^2 \Gamma \frac{(\alpha + j + 1)}{\alpha} + \Gamma \frac{(3\alpha + j + 1)}{\alpha} \right)$$

Order Statistics

Order statistics studies the arrangement of sample values in an ascending order and it depends on the ordering of values and not on the values themselves. Let $X_{(1)}, X_{(2)}, \ldots, X_{(n)}$be the order statistics of a random sample $X_1, X_2, \ldots, X_n$ drawn from a continuous population withprobability density function$f_X(x)$andcumulative distribution function with $F_X(x)$,then the probability density function of r^{th} order statistics $X_{(r)}$is given by

$$f_{x(r)}(x) = \frac{n!}{(r-1)!(n-r)!} \; f_X(x) \left(F_X(x) \right)^{r-1} \left(1 - F_X(x) \right)^{n-r} \qquad (11)$$

Using equations (5) and (7) in equation (11), we will obtain the probability density functionof r^{th}order statistics of length biased power Akash distribution which is given by

$$f_{x(r)}(x) = \frac{n!}{(r-1)!(n-r)!} \left(\frac{\alpha \theta^{\frac{3\alpha + 1}{\alpha}}}{\left(\theta^2 \Gamma \frac{(\alpha + 1)}{\alpha} + \Gamma \frac{(3\alpha + 1)}{\alpha} \right)} x^{\alpha} \left(1 + x^{2\alpha} \right) e^{-\theta x^{\alpha}} \right)$$

$$\times \left(\frac{1}{\left(\theta^2 \Gamma \frac{(\alpha + 1)}{\alpha} + \Gamma \frac{(3\alpha + 1)}{\alpha} \right)} \left(\theta^2 \gamma \left(\frac{(\alpha + 1)}{\alpha}, \theta x^{\alpha} \right) + \gamma \left(\frac{(3\alpha + 1)}{\alpha}, \theta x^{\alpha} \right) \right) \right)^{r-1}$$

$$\times \left(1 - \frac{1}{\left(\theta^2 \Gamma \frac{(\alpha + 1)}{\alpha} + \Gamma \frac{(3\alpha + 1)}{\alpha} \right)} \left(\theta^2 \gamma \left(\frac{(\alpha + 1)}{\alpha}, \theta x^{\alpha} \right) + \gamma \left(\frac{(3\alpha + 1)}{\alpha}, \theta x^{\alpha} \right) \right) \right)^{n-r}$$

Therefore, the probability density function of higher order statistic$X_{(n)}$ of length biased power Akash distribution can be obtained as

$$f_{x(n)}(x)=\frac{n\alpha\theta^{\frac{3\alpha+1}{\alpha}}}{\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}\right)}x^{\alpha}\left(1+x^{2\alpha}\right)e^{-\theta x^{\alpha}}$$

$$\times\left(\frac{1}{\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}\right)}\left(\theta^2\gamma\left(\frac{(\alpha+1)}{\alpha},\theta x^{\alpha}\right)+\gamma\left(\frac{(3\alpha+1)}{\alpha},\theta x^{\alpha}\right)\right)\right)^{n-1}$$

and the probability density function of first order statistic $X_{(1)}$of length biased power Akashdistribution can be obtained as

$$f_{x(1)}(x)=\frac{n\alpha\theta^{\frac{3\alpha+1}{\alpha}}}{\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}\right)}x^{\alpha}\left(1+x^{2\alpha}\right)e^{-\theta x^{\alpha}}$$

$$\times\left(1-\frac{1}{\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}\right)}\left(\theta^2\gamma\left(\frac{(\alpha+1)}{\alpha},\theta x^{\alpha}\right)+\gamma\left(\frac{(3\alpha+1)}{\alpha},\theta x^{\alpha}\right)\right)\right)^{n-1}$$

6. Likelihood Ratio Test

Let the random sample $X_1, X_2,\ldots X_n$ of size n drawn from the length biased power Akash distribution. To test we set up the hypothesis:

$H_o : f(x) = f(x;\theta,\alpha)$ against $H_1 : f(x) = f_l(x;\theta,\alpha)$

In order to test whether the random sample of size $n$comes from the power Akash distribution or length biased power Akash distribution, the following test statisticis used

$$\Delta=\frac{L_1}{L_o}=\prod_{i=1}^{n}\frac{f_l(x;\theta,\alpha)}{f(x;\theta,\alpha)}$$

$$\Delta=\frac{L_1}{L_o}=\prod_{i=1}^{n}\left(\frac{\alpha\theta^{\frac{1}{\alpha}}x_i\left(\theta^2+2\right)}{\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}}\right)$$

$$\Delta=\frac{L_1}{L_o}=\left(\frac{\alpha\theta^{\frac{1}{\alpha}}\left(\theta^2+2\right)}{\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}}\right)^{n}\prod_{i=1}^{n}x_i$$

We should refuse to accept the null hypothesis if

$$\Delta = \left(\frac{\alpha\theta^{\frac{1}{\alpha}}\left(\theta^2+2\right)}{\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}} \right)^n \prod_{i=1}^{n} x_i > k$$

$$\Delta^* = \prod_{i=1}^{n} x_i > k\left(\frac{\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}}{\alpha\theta^{\frac{1}{\alpha}}\left(\theta^2+2\right)} \right)^n$$

$$\text{or } \Delta^* = \prod_{i=1}^{n} x_i > k^* \qquad \text{Where } k^* = k\left(\frac{\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}}{\alpha\theta^{\frac{1}{\alpha}}\left(\theta^2+2\right)} \right)^n$$

When the sample of size n is large, $2log\ \Delta$ is distributed as chi-square distribution with one degree of freedom and also p-value is obtained from chi-square distribution. Thus, we refuse to accept the null hypothesis, when the probability value is given by

$p\left(\Delta^* > \beta^*\right)$, Where $\beta^* = \prod_{i=1}^{n} x_i$ is less than a particular level of significance and $\prod_{i=1}^{n} x_i$ is the observed value of the statistic Δ^*.

Bonferroni and Lorenz Curves

The bonferroni and Lorenz curves are the oldest classical curves used to measure the distribution of inequality in income and are also known as income distribution curves.The bonferroni and Lorenz curves are given by

$$B(p) = \frac{1}{p\mu_1'}\int_0^q x\, f(x)dx$$

$$\text{and } L(p) = pB(p) = \frac{1}{\mu_1'}\int_0^q x\, f(x)dx$$

$$\text{Where } \mu_1' = \frac{\theta^2\Gamma\frac{(\alpha+2)}{\alpha}+\Gamma\frac{(3\alpha+2)}{\alpha}}{\alpha\theta^{\frac{1}{\alpha}}\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}\right)} \quad \text{and } q = F^{-1}(p)$$

$$B(p) = \frac{\alpha\theta^{\frac{1}{\alpha}}\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}\right)}{p\left(\theta^2\Gamma\frac{(\alpha+2)}{\alpha}+\Gamma\frac{(3\alpha+2)}{\alpha}\right)}\int_0^q \frac{\alpha\theta^{\frac{3\alpha+1}{\alpha}}}{\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}\right)} x^{\alpha+1}\left(1+x^{2\alpha}\right)e^{-\theta x^{\alpha}}dx$$

$$B(p)=\frac{\alpha\theta^{\frac{3\alpha+2}{\alpha}}}{p\left(\theta^2\Gamma\frac{(\alpha+2)}{\alpha}+\Gamma\frac{(3\alpha+2)}{\alpha}\right)}\int_0^q x^{\alpha+1}\left(1+x^{2\alpha}\right)e^{-\theta x^{\alpha}}dx$$

$$B(p)=\frac{\alpha\theta^{\frac{3\alpha+2}{\alpha}}}{p\left(\theta^2\Gamma\frac{(\alpha+2)}{\alpha}+\Gamma\frac{(3\alpha+2)}{\alpha}\right)}\left(\int_0^q x^{\alpha+1}e^{-\theta x^{\alpha}}dx+\int_0^q x^{3\alpha+1}e^{-\theta x^{\alpha}}dx\right) \quad (12)$$

Put $x^{\alpha}=t \quad \Rightarrow \quad x=t^{\frac{1}{\alpha}}$

Also $\alpha x^{\alpha-1}dx=dt \quad \Rightarrow \quad dx=\frac{dt}{\alpha x^{\alpha-1}} \quad \Rightarrow dx=\frac{dt}{\alpha t^{\frac{\alpha-1}{\alpha}}}$

Aftersimplification of equation (12), we obtain

$$B(p)=\frac{\theta^{\frac{3\alpha+2}{\alpha}}}{p\left(\theta^2\Gamma\frac{(\alpha+2)}{\alpha}+\Gamma\frac{(3\alpha+2)}{\alpha}\right)}\left(\gamma\left(\frac{(\alpha+2)}{\alpha},\theta q\right)+\gamma\left(\frac{(3\alpha+2)}{\alpha},\theta q\right)\right)$$

$$L(p)=\frac{\theta^{\frac{3\alpha+2}{\alpha}}}{\left(\theta^2\Gamma\frac{(\alpha+2)}{\alpha}+\Gamma\frac{(3\alpha+2)}{\alpha}\right)}\left(\gamma\left(\frac{(\alpha+2)}{\alpha},\theta q\right)+\gamma\left(\frac{(3\alpha+2)}{\alpha},\theta q\right)\right)$$

Maximum Likelihood Estimator and Fisher's Information Matrix

In this section, we will estimate the parameters of length biased power Akash distribution by using the method of maximum likelihood estimator and also derive its Fisher's Information matrix. Let X1, X2,…,Xnbe a random sample of size nfrom the length biased power Akash distribution, then the likelihood function can be written as.

$$L(x)=\prod_{i=1}^{n}f_l(x)$$

$$L(x)=\prod_{i=1}^{n}\left(\frac{\alpha\theta^{\frac{3\alpha+1}{\alpha}}}{\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}\right)}x_i^{\alpha}\left(1+x_i^{2\alpha}\right)e^{-\theta x_i^{\alpha}}\right)$$

$$L(x)=\left(\frac{\alpha\theta^{\frac{3\alpha+1}{\alpha}}}{\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}\right)}\right)^n\prod_{i=1}^{n}\left(x_i{}^{\alpha}\left(1+x_i{}^{2\alpha}\right)e^{-\theta x_i{}^{\alpha}}\right)$$

$$L(x)=\frac{\alpha\theta^{n\left(\frac{3\alpha+1}{\alpha}\right)}}{\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}\right)^n}\prod_{i=1}^{n}\left(x_i{}^{\alpha}\left(1+x_i{}^{2\alpha}\right)e^{-\theta x_i{}^{\alpha}}\right)$$

The log likelihood function is given by

$$\log L=n\left(\frac{3\alpha+1}{\alpha}\right)\log\alpha\theta-n\log\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}\right)+\alpha\sum_{i=1}^{n}\log x_i+\sum_{i=1}^{n}\log\left(1+x_i{}^{2\alpha}\right)-\theta\sum_{i=1}^{n}x_i{}^{\alpha} \tag{13}$$

The maximum likelihood estimate of θ andαcan be obtained by differentiating equation (13) with respect to

$\theta$and α and must satisfy the normal equation

$$\frac{\partial\log L}{\partial\theta}=\frac{n\alpha}{\alpha\theta}\left(\frac{3\alpha+1}{\alpha}\right)-n\left(\frac{2\theta\Gamma\frac{(\alpha+1)}{\alpha}}{\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}}\right)-\sum_{i=1}^{n}x_i{}^{\alpha}=0$$

$$\frac{\partial\log L}{\partial\alpha}=-\frac{n\theta}{\alpha^3\theta}-n\psi\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}\right)+\sum_{i=1}^{n}\log x_i+\sum_{i=1}^{n}\frac{x_i{}^{2\alpha}\log x_i}{\left(1+x_i{}^{2\alpha}\right)}-\theta\sum_{i=1}^{n}x_i{}^{\alpha}\log x_i=0$$

Where ψ (.)is the digamma function.

Because of the complicated form of above likelihood equations, algebraically it is very difficult to solve the system of nonlinear equations. Therefore, we use R and wolfram mathematics for estimating the required parameters.

We obtain the confidence interval by using the asymptotic normality results. We have that if $\hat{\beta}=\left(\hat{\theta},\hat{\alpha}\right)$ denotes the MLE of $\beta=\left(\theta,\alpha\right)$, we can state the results as follows:

$$\sqrt{n}(\hat{\beta}-\beta)\rightarrow N_2\left(0,I^{-1}(\beta)\right)$$

Where $I(\beta)$ is the Fisher's Information matrix, i.e.,

$$I(\beta) = -\frac{1}{n}\begin{pmatrix} E\left(\frac{\partial^2 \log L}{\partial\theta^2}\right) & E\left(\frac{\partial^2 \log L}{\partial\theta\,\partial\alpha}\right) \\ E\left(\frac{\partial^2 \log L}{\partial\alpha\,\partial\theta}\right) & E\left(\frac{\partial^2 \log L}{\partial\alpha^2}\right) \end{pmatrix}$$

Here, we define

$$E\left(\frac{\partial^2 \log L}{\partial\theta^2}\right) = -\frac{n\alpha^2}{(\alpha\theta)^2}\left(\frac{3\alpha+1}{\alpha}\right) - n\left(\frac{\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}\right)\left(2\Gamma\frac{(\alpha+1)}{\alpha}\right)-\left(2\theta\Gamma\frac{(\alpha+1)}{\alpha}\right)^2}{\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}\right)^2}\right)$$

$$E\left(\frac{\partial^2 \log L}{\partial\alpha^2}\right) = \frac{3n\alpha^2\theta^2}{\left(\alpha^3\theta\right)^2} - n\psi'\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}\right) + \sum_{i=1}^{n}\frac{\left(1+x_i^{2\alpha}\right)x_i^{2\alpha}\left(\log x_i\right)^2-\left(x_i^{2\alpha}\log x_i\right)^2}{\left(1+x_i^{2\alpha}\right)^2}$$

$$-\theta\sum_{i=1}^{n}\left(x_i^{\alpha}\log x_i\right)^2$$

$$E\left(\frac{\partial^2 \log L}{\partial\theta\,\partial\alpha}\right) = -n\psi\left(\frac{2\theta\Gamma\frac{(\alpha+1)}{\alpha}}{\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}}\right) - \sum_{i=1}^{n}x_i^{\alpha}\log x_i$$

Where $\psi(.)'$ is the first order derivative of digamma function. Since β being unknown, we estimate $I^{-1}(\beta)$ by $I^{-1}(\hat{\beta})$ and this can be used to obtain asymptoticconfidence intervals for θ and α.

Entropy

The term entropy was introduced by Rudolf Clausius a German physicist (1865) and can be applied in various areas like probability and statistics, physics, communication theory and economics. Entropy of a random variable *X* is a measure of variation of the uncertainty.

Renyi entropy

The term Renyi entropy was given by Alfred Renyi (1957) and is important in ecology and statistics as index of diversity. The Renyi entropy of order$\beta$for a random variable *X* is given by.

$$e(\beta) = \frac{1}{1-\beta}\log\left(\int f^{\beta}(x)dx\right)$$

Where $\beta > 0$ and $\beta \neq 1$

$$e(\beta) = \frac{1}{1-\beta}\log\int_0^{\infty}\left(\frac{\alpha\theta^{\frac{3\alpha+1}{\alpha}}}{\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}\right)}x^{\alpha}\left(1+x^{2\alpha}\right)e^{-\theta x^{\alpha}}\right)^{\beta}dx$$

$$e(\beta) = \frac{1}{1-\beta}\log\left(\left(\frac{\alpha\theta^{\frac{3\alpha+1}{\alpha}}}{\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}\right)}\right)^{\beta}\int_0^{\infty}x^{\alpha\beta}\,e^{-\theta\beta x^{\alpha}}\left(1+x^{2\alpha}\right)^{\beta}dx\right) \qquad (14)$$

Using Binomial expansion in (14), we obtain

$$e(\beta)=\frac{1}{1-\beta}\log\left(\left(\frac{\alpha\theta^{\frac{3\alpha+1}{\alpha}}}{\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}\right)}\right)^{\beta}\sum_{i=0}^{\infty}\binom{\beta}{i}1^{\beta-i}\,x^{2\alpha i}\int_0^{\infty}x^{\alpha\beta}e^{-\theta\beta x^{\alpha}}dx\right)$$

$$e(\beta)=\frac{1}{1-\beta}\log\left(\left(\frac{\alpha\theta^{\frac{3\alpha+1}{\alpha}}}{\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}\right)}\right)^{\beta}\sum_{i=0}^{\infty}\binom{\beta}{i}\int_0^{\infty}x^{\alpha\beta+2\alpha i}\,e^{-\theta\beta x^{\alpha}}dx\right) \qquad (15)$$

Put $x^{\alpha}=t \;\Rightarrow x=t^{\frac{1}{\alpha}}$

$$\Rightarrow \alpha x^{\alpha-1}dx=dt \;\Rightarrow dx=\frac{dt}{\alpha x^{\alpha-1}}=\frac{dt}{\alpha t^{\frac{\alpha-1}{\alpha}}}$$

After simplification of equation (15), we obtain

$$S_{\lambda}=\frac{1}{\lambda-1}\left(1-\frac{1}{\alpha}\left(\frac{\alpha\theta^{\frac{3\alpha+1}{\alpha}}}{\left(\theta^2\Gamma\frac{(\alpha+1)}{\alpha}+\Gamma\frac{(3\alpha+1)}{\alpha}\right)}\right)^{\lambda}\sum_{i=0}^{\infty}\binom{\lambda}{i}\frac{\Gamma\frac{(\lambda\alpha+2\alpha i+1)}{\alpha}}{\lambda\theta^{\frac{\lambda\alpha+2\alpha i+1}{\alpha}}}\right)$$

Application

In this section, we have used two reallife time data sets in length biased power Akash distribution to show that the length biased power Akash distribution can be a better model than the power Akash, Akash exponential and Lindley distributions. The two real life time data sets are given below as: The first real life time data set represents the remission times (in months) of bladder cancer patients (n = 128) reported by Lee and Wang (2003) and the data set is given below in table 1.The second real life time data set represents the survival times (in months) of lung cancer patients is the non-censored data reported from Pena (2002).This data was recently used by L. S. Diab and E. S. El-Atfy (2017) in Paper "A moment inequality for overall decreasing life class of life distributions with hypothesis testing applications" and the data set is given below in table 2. The model comparison criterion values are estimated along with the unknown parameters through the technique of R software. In order to compare the length biased power Akash distribution with power Akash, Akash, exponential and Lindley distributions, we use the criterion values like Bayesian Information criterion (BIC), Akaike Information Criterion (AIC), Akaike Information Criterion Corrected (AICC) and -2logL. The better distribution is which corresponds to lesser values of *AIC*,*BIC*, *AICC* and -*2logL*. For the calculation of criterion values following formulas are applied.

$$AIC=2k-2\log L \qquad BIC=k\log n-2\log L \quad \text{and} \quad AICC=AIC+\frac{2k(k+1)}{n-k-1}$$

Where k is the number of parameters, n is the sample size and –2log$L$is the maximized value of log-likelihood function under the considered model. From table 3 given above, it can be easily observed and seen from the results that the length biased power Akash distribution have the lesser *AIC*, *BIC*, *AICC* and -*2logL* values as compared to

power Akash, Akash, exponential and Lindley distributions. Hence it can be concluded that the length biased power Akash distribution fits better over power Akash, Akash, exponential and Lindley distributions.

CONCLUSION

The present paper approaches a new distribution named as length biased power Akash distribution. Different statistical properties of the new distribution including its mean, variance, reliability measures, order statistics, bonferroni and Lorenz curves, Renyi entropy and Tsallis entropy were studied. For estimating its parameters the method of maximum likelihood estimator has been used and also its Fisher's information matrix has been investigated. Finally, the two real life time data sets from medical sciences have been fitted in new distribution and the fit has been found to be good.

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Table 1: Data regarding bladder cancer patients reported by Lee and Wang (2003)

0.08	2.09	3.48	4.87	6.94	8.66	13.11	23.63	0.20	2.23
3.52	4.98	6.97	9.02	13.29	0.40	2.26	3.57	5.06	7.09
9.22	13.80	25.74	0.50	2.46	3.64	5.09	7.26	9.47	14.24
25.82	0.51	2.54	3.70	5.17	7.28	9.74	14.76	6.31	0.81
2.62	3.82	5.32	7.32	10.06	14.77	32.15	2.64	3.88	5.32
7.39	10.34	14.83	34.26	0.90	2.69	4.18	5.34	7.59	10.66
15.96	36.66	1.05	2.69	4.23	5.41	7.62	10.75	16.62	43.01
1.19	2.75	4.26	5.41	7.63	17.12	46.12	1.26	2.83	4.33
5.49	7.66	11.25	17.14	79.05	1.35	2.87	5.62	7.87	11.64
17.36	1.40	3.02	4.34	5.71	7.93	11.79	18.10	1.46	4.40
5.85	8.26	11.98	19.13	1.76	3.25	4.50	6.25	8.37	12.02
2.02	3.31	4.51	6.54	8.53	12.03	20.28	2.02	3.36	6.76
12.07	21.73	2.07	3.36	6.93	8.65	12.63	22.69		

Table 2: Data regarding survival times (in months) for lung cancer patients.

0.99	1.28	1.77	1.97	2.17	2.63	2.66	2.76	2.79	2.86
2.99	3.06	3.15	3.45	3.71	3.75	3.81	4.11	4.27	4.34
4.40	4.63	4.73	4.93	4.93	5.03	5.16	5.17	5.49	5.68
5.72	5.85	5.98	8.15	8.62	8.48	8.61	9.46	9.53	10.05
10.15	10.94	10.94	11.24	11.63	12.26	12.65	12.78	13.18	13.47
13.96	14.88	15.05	15.31	16.13	16.46	17.45	17.61	18.20	18.37
19.06	20.70	22.54	23.36						

Table 3 shows values of ML estimates, standard errors and Performance of fitted distributions

Data sets	Distribution	MLE	S.E	- 2logL	AIC	BIC	AICC
1	Length Biased Power Akash	$\hat{\alpha} = 0.55743117$ $\hat{\theta} = 0.97431782$	$\hat{\alpha} = 0.01695729$ $\hat{\theta} = 0.05361568$	384.1353	388.1353	393.8394	388.2313
	Power Akash	$\hat{\alpha} = 0.50323563$ $\hat{\theta} = 0.88992717$	$\hat{\alpha} = 0.02528374$ $\hat{\theta} = 0.05766657$	588.6464	592.6464	598.3505	592.7424
	Akash	$\hat{\theta} = 0.3154623$	$\hat{\theta} = 0.0158728$	881.0378	883.0378	885.8898	883.0695
	Exponential	$\hat{\theta} = 0.108588071$	$\hat{\theta} = 0.009597106$	824.3768	826.3768	829.2289	826.4085
	Lindley	$\hat{\theta} = 0.1991393$	$\hat{\theta} = 0.0125326$	833.7925	835.7925	838.6445	835.8242
2	Length Biased Power Akash	$\hat{\alpha} = 0.57552571$ $\hat{\theta} = 0.93000787$	$\hat{\alpha} = 0.02497406$ $\hat{\theta} = 0.07231808$	164.9005	168.9005	173.2183	169.0972
	Power Akash	$\hat{\alpha} = 0.53761651$ $\hat{\theta} = 0.82641916$	$\hat{\alpha} = 0.03879194$ $\hat{\theta} = 0.07863753$	289.084	293.084	297.4017	293.2807
	Akash	$\hat{\theta} = 0.3324107$	$\hat{\theta} = 0.0236232$	393.8934	395.8934	398.0523	395.9579
	Exponential	$\hat{\theta} = 0.11481347$	$\hat{\theta} = 0.01435059$	405.0524	407.0524	409.2113	407.1169
	Lindley	$\hat{\theta} = 0.20971909$	$\hat{\theta} = 0.01867716$	392.0752	394.0752	396.234	394.1397

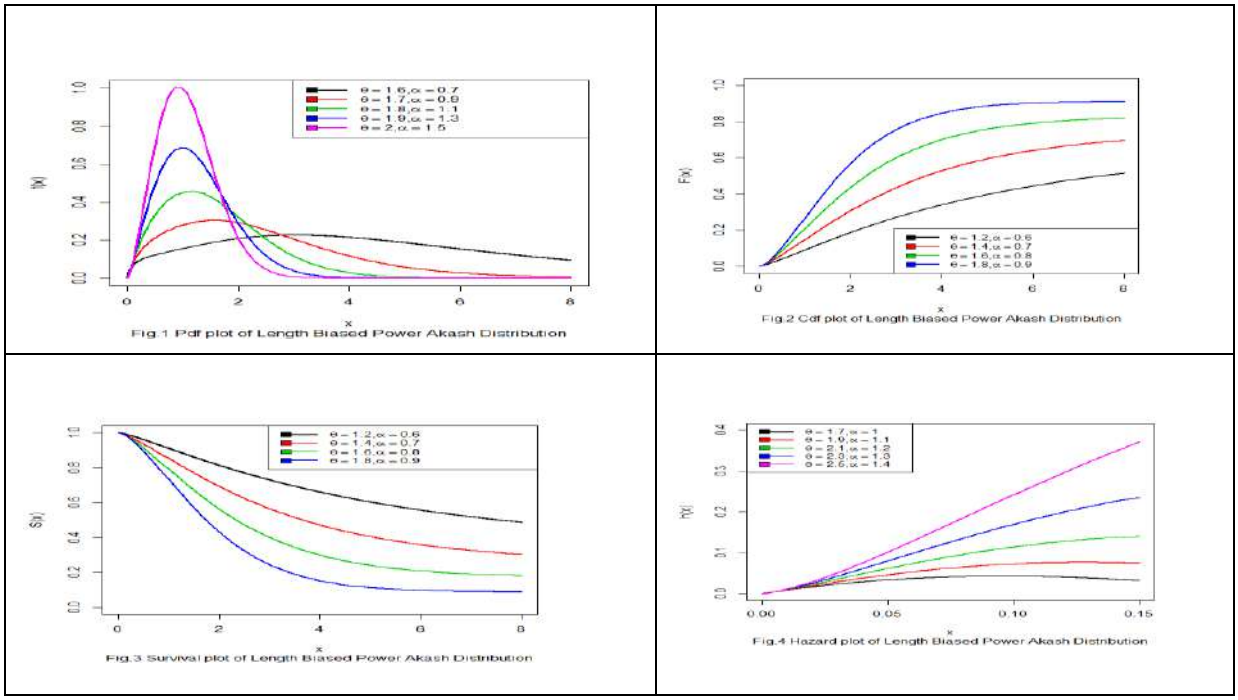

Fig.1 Pdf plot of Length Biased Power Akash Distribution

Fig.2 Cdf plot of Length Biased Power Akash Distribution

Fig.3 Survival plot of Length Biased Power Akash Distribution

Fig.4 Hazard plot of Length Biased Power Akash Distribution

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REVIEW ARTICLE

A Review of Schiff Base Complexes and Their Biological Activities

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ABSTRACT

The most commonly used organic chemicals are Schiff bases. These compounds have been demonstrated to have antipyretic, antimalarial, antibacterial, antiproliferative, antiviral, anti-inflammatory, and antifungal, effects, among other biological actions. Schiff bases are flexible ligands that are created by combining primary amines with carbonyl groups. These chemicals are extremely essential in the real of medicine and pharmaceuticals. Transition metal complexes having biological activity produced from Schiff base ligands have been extensively explored. The synthesis of Schiff bases complexes and their biological activities are summarised in this article.

Keywords: Schiff bases, antitumor activity, antimicrobial activity, Metal complexes, Biological Activities.

INTRODUCTION

SYNTHESIS OF SCHIFF BASE

The nucleophillic assault of amines on the electrophilic carbon of aldehydes or ketones is a popular technique of production of Schiff base. This reaction produces a molecule in which the C=O double bond has been replaced by a C=N double bond. An imine, often known as a Schiff base, is a compound of this sort. Due to its various of functions, such as medicine [1,2], catalysts [3,4], anti-corrosion agents [5,6], and crystal engineering [7], Schiff base compounds and their metal complexes have been intensively explored. Schiff bases and their clusters with complexing with oxygen, nitrogen, and other donors have been used as drugs and mentioned to have a wide range of biological activities against bacteria, fungi, and certain types of tumours, as well as a variety of biochemical, clinical, and pharmacological properties [8,12].

Schiff bases are bi- or tridentate ligands that can produce extremely stable transition metal complexes. Liquid crystals are made from some of them. Schiff base reactions can be used to form carbon-nitrogen bonds in chemical synthesis. Schiff bases likely to be a crucial step in a number of enzymatic processes involving the interaction of an enzyme with a substrate's amino or carbonyl group. The metabolic process, which includes the condensation of a primary amine in an enzyme, usually a lysine residue, with a carbonyl group of the substrate to generate an imine, or Schiff base, is among the most essential types of catalytic mechanisms.

The synthesis and biological action of Schiff bases and their complexes are the focus of this review [13]. Azam Faizul et al [14] have investigated a series of 2-benzylideneaminonaphthothiazoles that are produced with the lyophilic naphthalene ring to improve their ability to penetrate bio membranes. The findings suggest that Schiff bases with halogen substitutions, hydroxyl groups, and nitro groups at the phenyl ring have good antibacterial activity, whereas methoxy groups at various places in the aromatic ring have a little effect in inhibitory activity. Patil KS et al [15] Cu+2, Ni+2, and Co+2 ions were reported to have mixed ligand transition compounds with Schiff base ligands generated from the condensation of o-hydroxy benzaldehyde with amino phenols and nitrogen donor amine bases. The compounds' antibacterial and antifungal properties were also investigated by the authors.

Spinu *et al* [16] There have been reports of metal complexes ML2Cl2 where M is Fe (II), Co (II), Ni(II), Cu(II), Zn(II), or Cd(II) and L is the Schiff base produced via the condensation of 2-thiophenecarboxaldehyde with 2-aminopyridine, N-(2-thienylmethylidene)-2-aminopyridine (TNAPY). Yi-Jun Wei *et al* [17] The Schiff base ligand, 4-nitro-2-[(2- diethylaminoethylimino)methyl]phenol, was used to create a pair of iso structural azido or thiocyanato bridged core of symmetric dinuclear copper(II) complexes. Elemental analyses, IR spectra, and single X-ray diffraction are used to identify these substances. The complexes' antibacterial properties have been investigated. Gudasi *et al* [18] The synthesis, characterisation, and biological investigations of dioxouranium(II) and thorium(IV) Schiff base complexes generated from 2-amino pyridine and acetophenones have been published.

Spinu C et al [19] Because aromatic ring substitution can change the electronic and steric properties of the resulting complexes, fine-tuning of properties is possible. Given the widespread use of ligands in transition metal chemistry, it's surprising that main group metals and lanthanoids have received so little attention. The goal of this research is to look into the chemistry of these salen ligands in Groups 1 and 2 and to make some "cage complexes" with lanthanoid metals. Our strategy will cover a number of fronts. Patel NH et al [20] Elemental analysis, magnetic measurements, thermogravimetry, infrared and electronic absorption spectroscopy were used to prepare and characterise mixed ligand complexes of the type [M(SB) 2 acphen], where M=Mn(II), Co(II), Ni(II), Cu(II), and Cd(II), HSP=3,5-tribromosalicylidineanilin, and acphen= bis(acetophen The octahedral geometry is

present in all of the mixed ligand complexes. Antimicrobial activity has been observed in the mixed ligand complexes against bacteria, yeast, and fungus Bag et al[21] have created a number of benzidene Schiff bases and investigated the mercuration reaction Spinu *et al* [22] a new base for the Schiff Zn(II), Cd(II), Sn(II), and Pb(II) complexes of 2- aminophenol-pyrrole - 2- carboxaldehyde To assess the antibacterial properties of the ligands and their complexes, the bio efficacy of the ligands and their complexes was tested in vitro against the growth of bacteria. The ligands and complexes have excellent activity against E. coli (100 ppm) bacteria, whereas others were very effective against S. aureus (100 ppm). For both bacteria, the zinc complex outperformed other metal complexes.

BIOLOGICAL ACTIVITIES

Tea has provided human populations with vitality and passion for ages. It contains a high concentration of tannis and flavonoids which have anticarcinogenic, antimutagenic, and antioxidative properties[23,24]. Phospholipase D (PLD) activity can be regulated by hexanal and inositol, which can be used to keep fruits fresh, reduce weight loss, and retain firmness [25]. However, this substance is harmful to human lung epithelial cells[26]. The detection of excess hexanal in fruit packages has recently been developed using an olfactory-nanovesicle-fused carbon-nanotube-transistor biosensor (OCB)[27]. Negatively charged amines stabilise Schiff bases [28,29]. Schiff bases are ideal ligands for complexation, catalysis, and synthetic organic chemistry because they may form complexes with a wide range of

metal ions[30]. Schiff bases have been discovered to have therapeutic properties in nature. Schiff bases have anti-plasmodial, anti-inflammatory, antioxidant, and antibacterial properties, to name a few [31].

Details of the computational research

Gaussian-09 software was used to optimise derivatives of hexanal compounds[32]. Using DFT-B3LYP[33,34].Process and G(2d,p)+ 6-311[35,36]. as a starting point The IR spectra are generated using frequency calculations. We employed TD-DFT with the long-range adjusted CAM-B3LYP function to simulate the UV–visible spectrum[37,38].

Equilibrium of proton transport in Schiff bases.

Measurements of deuterium isotope effects on chemical shift are particularly useful in proton transfer equilibrium research. The presence of proton transfer equilibria can be detected using this method, and the mole fractions of tautomers can be determined. For a partially deuterated material, measurements of deuterium isotope effects on chemical shifts can be done in a single tube experiment. Deuterium isotope effects on 13C-NMR chemical shifts were used to identify the position of the proton transfer equilibrium in Schiff bases [39]. Differences between the 13C signals in the spectra of non-deuterated and deuterated species were used to calculate the deuterium isotope effects: $n\Delta C(D) = \delta C(H) - \delta C(D)$.

Ionic liquid-supported Schiff bases use Anti-cancerdrugs

Cancer is among the most serious human health issues, and it is the second leading cause of death worldwide [40,41]. Cancer has advanced significantly in the modern era, and it is expected to affect 25 million people within next 20 years [42]. Breast cancer is the most common cancer among women worldwide, and it is still the leading cause of mortality among women. It is responsible for approximately 450,000 fatalities worldwide each year [43]. Surgical excision of the tumour or radiotherapy followed by chemotherapy are the current treatment options[44]. Although chemotherapy and radiotherapy are widely used to treat a variety of malignancies, they have a number of drawbacks, including I non-selectivity and damaging side effects on normal cells. (ii) chemotherapeutic drug resistance; and (ii) narrow-spectrum[45]. An unlimited number of researchers have shown tremendous interest in nitrogen- and sulfur-containing heterocyclic compounds for the synthesis of novel biomolecules to enhance their therapeutic potential in pharmaceutical applications throughout the last few decades[46,47]. 2-aminothiazole (AT) and its derivatives, which are found in many natural products, are always attractive bioactive scaffolds for designing and developing different pharmacological medicines with exceptional biological properties[33]. Notably, due to their biological performances in a variety of fields [48], including anticancer efficacy [49], Schiff bases have piqued the interest of numerous pharmacological researchers. Interestingly, the exceptional and amazing physicochemical properties of ionic liquids (ILs) attract many researchers to design numerous smart materials, making them inimitably suited for applications in many fields such as synthesis [50], electrochemistry [51], analytics [52], active pharmaceutical ingredients (API) [53], extraction [54], and so on. Ionic liquid-supported Schiff bases have recently been successfully employed as chemical sensors [55,56] as well as to convert harmful pollutants (primary amines and heavy metal ions) into medicinal candi- dates [57,58].

Highly efficient three component amino acid ionic liquid bound copper Schiff base catalysed reaction

Ionic liquids (ILs) have recently found widespread use in various fields, such as electrolytes in electrochemistry and green reaction media in organic syntheses, due to their unique properties such as higher thermal stability, non-volatility, high solvation power for organic and inorganic compounds, and low flammability[59,60]. for biphasic catalysis [61,62] and immobilising phases Metal-containing ILs, in particular, have been proven to be more toxic. Because they combine the features of ILs with the catalytic properties of the inserted metal salts, task-specific functionalized liquids are promising [63,64]. Ionic liquids with imidazolium ions as the cationic moiety and fluorinated anions such as BF4, PF6 as the anionic counters are commonly utilised [65,66]. Most of these ionic liquids are susceptible to hydrolysis and release HF when exposed to moisture, making them less environmentally friendly. As a result, the development of "truly green" ionic liquids starting from non-toxic and biodegradable precursors is critical from both an environmental and economic standpoint. Following the effective synthesis of amino acids as anions or cations by in 2005 [67], a number of amino acid-based ionic liquids have been developed [68,69].

Ionic liquid-supported Schiff bases of amino acids

Ionic liquids (ILs), which are made entirely of ions [70] and are liquid at room temperature [71], have been extensively researched as solvents for various processes. Ionic liquids have a low vapour pressure, which results in lower air emissions, non-flammability, and non-explosiveness [72-74]. In addition, by carefully selecting cations and anions, additional physical properties of ILs including as polarity, hydrophobicity, hydrogen-bond basicity, viscosity, and solvation interactions with organic and inorganic molecules can be precisely regulated [75-79].A new generation of ionic liquids derived from natural raw materials such as amino acids has recently received a lot of interest. Traditional ionic liquids based entirely on petrochemical raw materials have been replaced by amino acid ionic liquids. Amino Acid Ionic Liquids (AAILs) made from biorenewable raw materials have higher biocompatibility (as measured by their ability to biodegrade in the environment) and reduced toxicity (both ecotoxicity and cytotoxicity) [80,81].Furthermore, the ability to use amino acid ionic liquid-supported Schiff bases as chiral solvents and catalytic ligands makes this family of molecules particularly attractive. Ionic liquid-supported Schiff bases[82-91], which are derivatives of 1-(2-aminoethyl)-3-methylimidazolium hexafluorophosphate and aromatic aldehydes, have been studied as ligands and solvents for the Pd-catalyzed Suzuki-Miyaura coupling process, yielding good to exceptional biaryl yields [92,93].

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CONCLUSION

Schiff base ligands are regarded as favoured ligands since they may be easily synthesised from aldehyde derivatives and primary amines. These compounds and their metal complexes have a wide spectrum of uses, including therapeutic, analytical, agrochemical, and commercial processesbiological activities. They also serve as catalysts and antifouling. The biological activities of Schiff base and its complexes have been outlined in this study from 2001 to 2021.

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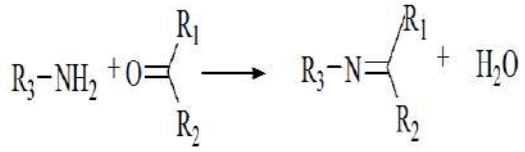
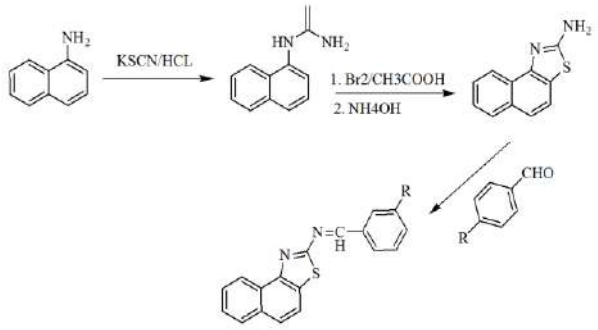
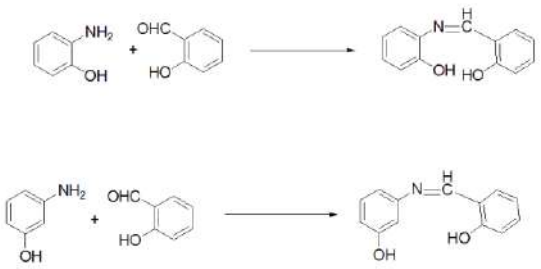


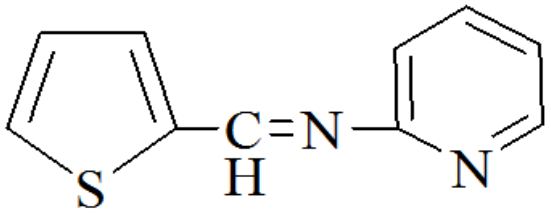
Scheme 1



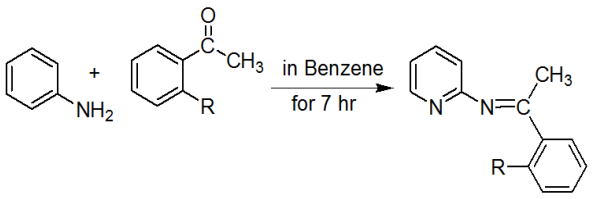
Scheme 2



Scheme 3



Scheme 4



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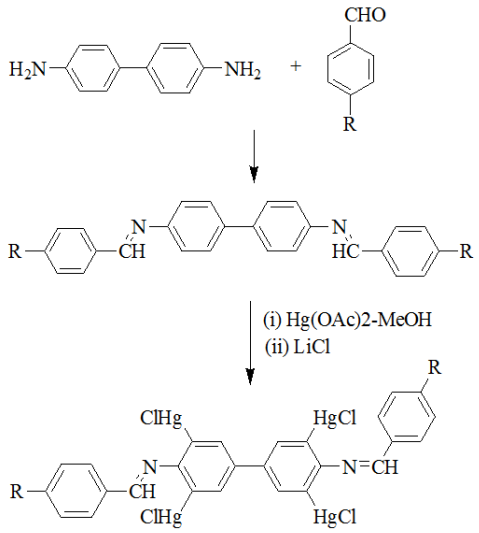
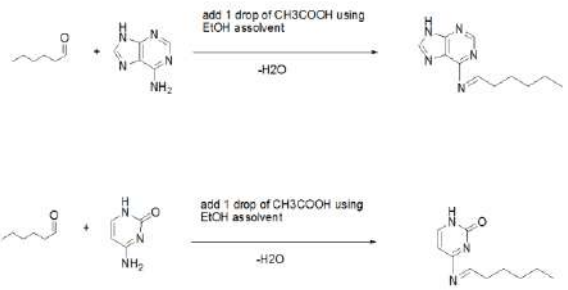
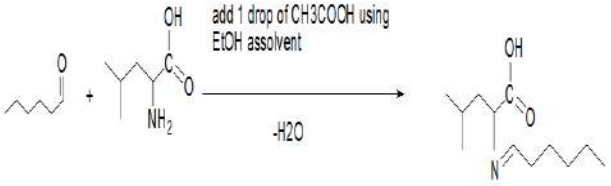


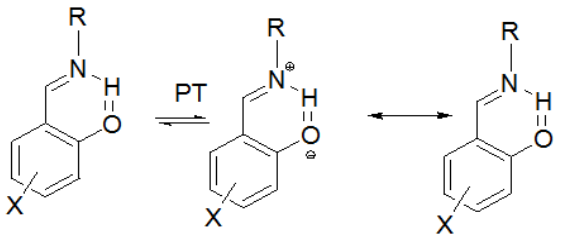
Scheme 6



Scheme 7



Scheme 8



Scheme 9

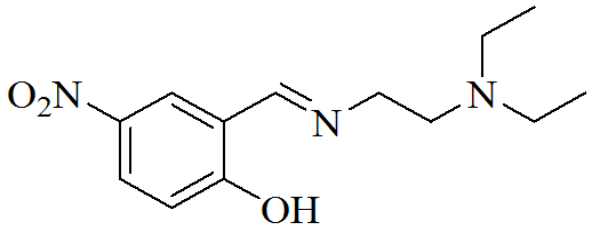
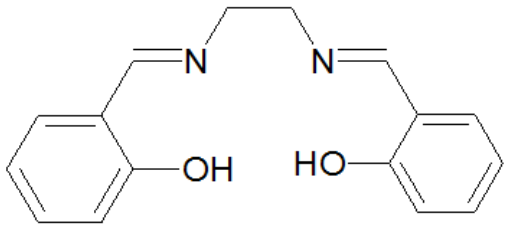
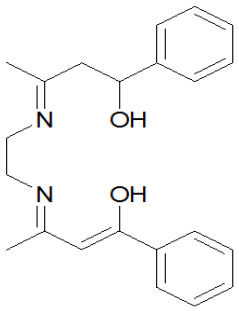


Fig.1.



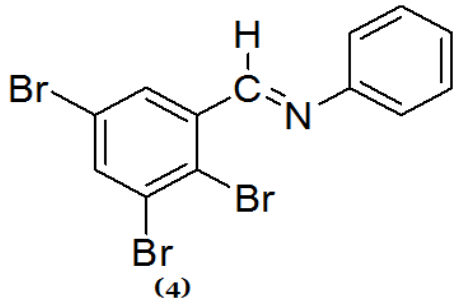
(2)

Fig.2.



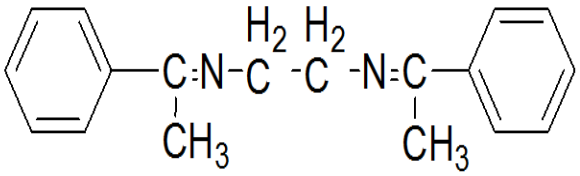
(3)

Fig.3.



(4)

Fig.4.



(5)

Fig.5.

REVIEW ARTICLE

Secondary Metabolites from Marine *Streptomyces* and their Applications

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ABSTRACT

The papers discussed in this section detail the *Streptomyces* identified in these diverse vertically demarcated marine environments. These *Streptomyces sp* may be found all over the ocean, isolated geographically, and impacted by a variety of geophysical factors as temperature, salinity, subsurface geochemistry, and ocean currents. Streptomyces in the environment of the sea only 7–8% of the whole ocean's surface is coastal, While the majority of the area is underwater, with water depths of greater than 2000 meter covering 60% of it. Streptomyces is a Gram-positive bacterium genus that grows in a filamentous form, similar to mushrooms, and thrives in a variety of conditions. The formation of a covering of hyphae capable of dividing into a spore chain is required for morphological characterization of Streptomyces. They're also crucial for organic matter mineralization, mineral nutrient immobilization, nitrogen fixation, physical parameter enhancement, and environmental protection. Actinomycetes, particularly those of the genus Streptomyces, can produce a diverse spectrum of secondary metabolites, including antibiotics, as biologically active molecules. It has effective antimicrobial, antifungal, anticancer, and antimalarial activity.

Keywords: *Streptomyces*, Antagonistic activity, Anbacterial activity, Anticancer activity.

INTRODUCTION

The marine environment includes a variety of habitats, ranging from the microlayer of the sea surface to the large water layer (which contains marine creatures and marine drift) that stretches from a few mm to several meter more than 10,000 feet below the surface depth, and finally to habitats on and beneath the seafloor. Sediments of various geoscience, mining cluster sites, limestone mound, cool leaks, petroleum seeps, saturated saltwater and hydrothermal vents are some of the habitats on the seafloor. The Actinobacteria that can be found in these horizontally demarcated marine environments are described in the papers reviewed here. These Actinobacteria are found Separated geographically over oceanic areas, separated geographically, and are impacted by a variety of geological variables such as temperature, salinity, underlying geochemistry, and ocean currents. Although the seascape does have an incredible diversity of species, the seas have the most biodiversity [1]. Oceans encompass approximately 70% of our planet's surface, and life on Earth had its origins in the water. Experts estimate that biological diversity in some marine environments, for example, the depth of seabed and coral reefs, is greater than tropical rainforests [2]. Because marine and terrestrial environmental conditions are so dissimilar, it's anticipated that Streptomyces in the sea have distinct properties than their terrestrial counterparts and as a result, produce different forms of bioactive components [3].

Marine Environment Streptomyces

Streptomyces in the sea only 7–8% among the ocean's total area is coastal, while the remainder is deep sea, with 60% of it covered by water deeper than 2000 meters. Low temperature, high pressure, a lack of light, and changing salt and oxygen concentrations characterize the deep sea, making it a rare and extreme environment [4]. Despite the immense geographical extent of the deep sea, scientific knowledge and investigation on the microbiological diversity in the deep sea are limited [5]. It has, however, been proved to be an excellent source of novel microbes for antibiotic development. Earlier research found actinomycetes in deep marine sediments, but they were poorly described [6]. Goodfellow and Williams 1983). Culture-independent research has recently shown that indigenous marine streptomyces oceans do, in fact, exist [7]. Members of the genus are included [8]. Streptomyces [9]. The newly described genera Salinispora [10] and Marinispora [11] both need seawater to grow and exhibit marine chemotype signatures and *Aeromicrobium marinum* [12]. It also has a necessary salt requirement. *Salinibacterium*, a newly discovered genus, can with stand NaCl concentrations of up to 10% are possible but has no salt need to promote development [13]. The recently described *Verrucosispora* strain AB-18-032 [14] may also identify as a native marine streptomyces. Some of these species create salinosporamides, for example, are new chemical compounds, which are presently being tested as effective anticancer drugs in clinical studies [15]. Actinomycetes are important components of marine microbial communities, forming stable, long-term populations in a variety of marine habitats [16] and their ability to establish stable populations in a variety of environments while also producing novel compounds with a variety of biological activity [17]. The findings clearly show indigenous marine streptomyces do occur in the seas and are a source of food valuable source is a kind of secondary metabolites. Streptomyces mainly use the antibiotic production (Figure 1).

Streptomyces

Streptomyces is a Gram +ve bacterial genus that grows in a filamentous form, related to fungi and thrives in a variety of environments. Streptomyces morphological characterization requires the formation of a layer of hyphae capable of differentiating into a spore chain. This is a unique Gram-positive mechanism that necessitates a well-coordinated and specialized metabolism. The potential of Streptomyces to synthesize Antifungals, antivirals, antitumorals, and anti-hypertensives are examples of bioactive secondary metabolites is its most intriguing feature [18]. Another distinguishing feature is a member of the genus is complicated multicellular growth. In which hyphae spores germinate with multinuclear aerial mycelium, which produces septa at regular intervals, forming a chain of uninucleated spores [19] (Figure 2).

Marine Streptomyces

Streptomyces have become an economically significant category of organisms among actinomycetes, and they are a a significant source of a wide range of biologically active substances [20]. Streptomycetes produced around 3 of the total commercially and medicinally relevant antibiotics [21] as well as a number of essential agricultural compounds [22]. Additionally, Streptomyces is a genus responsible for nearly 60% of antibiotics found since 1990, as well as the majority of antibiotics used in farming [23]. Streptomyces have demonstrated that they are able to producing antibacterial compounds such as antibacterial (24 Atta 2007) As a result, they are well recognized as important industrial microbes [25]. They're also recognized for being able to produce a variety of extracellular hydrolytic enzymes, such as ribonucleases [26]. Because of these features, this genus is an important academic and industrial study area. Streptomyces, which are important sources in the pharmaceutical sector and prolific manufacturers of antibiotics, may generate a diverse spectrum of secondary metabolites. Drug resistance in pathogenic microbes [27] and the extraction of previously known metabolites [28] from terrestrial environments drew researchers to a variety of ecological niches. Although demonstrated the presence in the marine sector of actinomycetes, no extensive research were conducted until the last decade. However, current study has discovered that several taxa of actinomycetes are either natural or well-adapted in marine residents. Antibiotics, anticancer chemicals, immunosuppressants, antiviral, antiparasitic, and enzyme-inactivating substances are all derived from microorganisms. Only 150 was approximately 23,000 bioactive secondary metabolites are synthesized by microbes have been documented for use in pharmacology, agriculture, or other sectors. Actinomycetes synthesize over 10,000 of these chemicals, accounting for 45 percent of all bioactive microbial metabolites identified, and 80 percent if just those molecules in practical application are considered. Streptomyces species produce roughly 7600 chemicals among actinomycetes.

Streptomyces role in the Marine Environment

Streptomyces producing antibiotics, actinomycetes play an important function inside a marine environment [29]. Decomposition and recycling of different materials is a constant process mediated by a variety of microbes [30]. It's possible that the increase or decrease of a specific enzyme-producing microbe reflects the concentration of natural substrate and environmental conditions [31] investigated the ability of marine organisms to break down cellulosic materials actinomycetes [32] reported chitinolytic actinomycetes, and several industrially important enzyme synthesizing actinomycetes have been documented. Actinomycetes have been associated to degradation and regeneration of organic substances. They also serve an a significant role in the mineralization of organic matter, the immobilization of mineral nutrients, nitrogen fixation, physical parameter improvement, and environmental protection [33] (Figure 3).

Marine Actinobacterial Secondary Metabolites

Actinomycetes, particularly those of the genus Streptomyces, can create a large number of secondary metabolites, including antibiotics, as biologically active compounds. The majority of antibiotics that are currently in use are derivatives of actinomycetes and fungus natural products (Table 1).

Antibiotics

Actinomycetes (and other microbes) have been producing antibiotics for 1 billion years and their fitness has been determined by their capacity to infiltrate other microbes and block target enzymes, macromolecules. Actinomycetes produced by chloroeremomycin, erythromycin, vancomycin, daptomycin, capreomycin, tobramycin, echinocandin B and many more b-lactam Antibiotics are one of the most significant antimicrobial pharmacological agents (Figure 4).

Enzymes

Actinobacteria from the sea have a diverse range of enzyme activity and can catalyse a variety of metabolic reactions. The Streptomyces producing enzymes such as [59], Protease [60] [61], Chitinase [62], Keratinase [63] and Xylanase [64] Bode and Huber have been obtained from the marine actinobacteria.

Single Cell Protein

Secondary metabolites synthesized by actinobacteria are recognised to promote in the growth of prawns, shrimp, and juvenile fish. The growth, food conversion efficiency, and protein content of juvenile prawn and shrimp fed on actinobacteria-incorporated feed have all been improved. As a result, among alternative protein sources, microbial SCP (single cell protein) looks to be a kind of protein potential substitute for fishmeal, capable of replacing up to 50% of fishmeal in aquaculture farms. The potential of *Actinopolyspora spp* a newly identified actinobacterial strain, to synthesis single cell protein was investigated (Figure 5).

Probiotics

Marine *Streptomyces* sp have received less attention as probiotics in aquaculture while being the numerous sources of new antibiotics. Furthermore, marine Streptomyces were recommended as prospective candidates for use in marine aquaculture according to their capacity to breakdown starch and protein macromolecules in cultivation pond water, marine Streptomyces are indicated as potential probiotic strains. Antimicrobial compounds are produced heat and desiccation tolerant spores are formed. Some a few researches on the potential Streptomyces from the sea have been used to treat a variety of illnesses [65].

Activity of Bioactive Compounds

Bioactive compounds found in the marine becoming more essential in the production foods that are useful and antimicrobial, anticancer, antioxidant, and other characteristics of medicines (Figure 6).

Anbacterial Activity

An antibacterial agent is a compound that inhibits or kills bacteria. Antibiotic-resistant microorganisms continue to make infectious diseases one of the leading causes of death. Antibiotic efficacy has decreased, and disease resistance has increased, the finding of new information [66]. Marine actinobacteria have antibacterial properties has been widely researched. Abyssomicin C is a new polycyclic polyketide antibiotic synthesized by a *Verrucosispora* strain from the sea [67]. It is a strong biosynthesis of para-aminobenzoic acid inhibitor and so inhibits folic acid biosynthesis earlier than well-known synthetic sulfa medications [68]. Abyssomicin C is effective against Gram positive bacteria, such as *Staphylococcus aureus*, which is resistant to several antibiotics including vancomycin. Bonactin was found to have antibacterial and antifungal properties against Gram-positive and Gram-negative bacteria.

Antifungal Activity

Antibiotics have been separated from many different bacteria. However, research is continuously being done to find new antibiotics that are efficient against pathogenic fungus [67]. Antifungal compounds are produced by marine actinobacteria, which are helpful biological agents in the fight fungus-resistant [70]. Saprophytic Streptomyces species in nature and are frequently found in soils, they play a major role in the breakdown of complex biopolymers. Chitinase was synthesised by actinomycetes, which has antifungal properties against *Candida albicans* and *Aspergillus niger* [72].

Anticancer Activity

Breast cancer is the second leading major cause of death in women behind lung cancer, and it is still one of the most serious human health problems [73]. Cancer therapeutic interventions include surgery, radiation, immunotherapy, and chemotherapy [74] and while each of these treatments is valuable in its own right, when combined, they provide a more effective tumour treatment. Many antitumor compounds found in marine drugs come from marine actinobacteria. These metabolites are crucial in the identification of medicinal substances [75]. Only a few researches have been done appear to have focused on discovering bioactive chemicals produced from marine actinobacteria that could be exploited as anticancer treatments, as well as antimicrobials and anti-infectious agents. Many malignant cell types have been demonstrated to be inhibited by extracted purified bioactive compounds from marine actinobacteria such as *Salinispora tropica* [76].

Anti-Malarial Activity

Anti-malarial properties of *Plasmodium parasites* are the cause of malaria. Every year, it causes approximately 300,000,000 clinical cases and over 2 million deaths. The parasite *Plasmodium falciparum*, which causes the most fatal form of the disease, is getting increasingly resistant to practically every anti-malarial medicine on the industry. To treat this disease, new chemotherapeutic techniques are urgently required [77]. *Streptomyces ochraceus* and S*treptomyces bottropensis* are two strains of Streptomyces produced trioxacarcin A, B, and C. Trioxacarcins are complex compounds with increased antimalarial activity against malarial infections, as well as anticancer and antibacterial properties in some cases [78]. Some of these components have been shown to have extraordinarily strong antiplasmodial activity, comparable with those of artemisinin, the most potent drug against the malaria pathogen.

DISCUSSION AND CONCLUSION

The pharmaceutical industry's economic future is dependent on the discovery or development of novel compounds with new activities or targeted towards a more specialised market. The number of secondary metabolites is continually increasing combinatorial biosynthesis generates new compounds. Since marine microorganisms, especially actinomycetes, having developed the highest genetic and metabolic diversity, the focus of efforts should be on researching actinomycetes from the marine as a source for the identification the discovery of novel secondary metabolites. Recent tradition research [79] have demonstrated that unusual actinomycetes still exist in large numbers in an ocean environment Studies on the prevalence and spread of marine actinomycetes that are not culture dependent. The information gathered from this research has also been utilised to develop selective isolation strategies that have enabled the separation of a diverse variety of marine actinomycetes [80].

ACKNOWLEDGEMENT

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Table 1: Uses of antibiotics producing from *Streptomyces* sp

S.No	Bioactive compounds	Strain	Uses	References
1	Actinomycin	*S. antibioticus*	Ribosome Engineering	[34]
2	Essramycin	*Streptomyces* Merv8102	Antimicrobial assay	[35]
3	Lipoxazolidionone A	*Marinospora* NPS12745	Activity against MRSA	[36]
4	Nocapyrones E-G	*Nocardiopsis dassonvillei* HR10-5	Against *Bacillus substilis*	[37]
5	Marinomycins	*Marinispora*	Antibacterial, Anticancer	[38]
6	Himalomycins	*Streptomyces sp.*	Antibacterial	[39]
7	Glaciapyrroles	*Streptomyces sp.*	Antibacterial	[40]
8	Chloro-dihydroquinones	*Novel actinomycete*	Antibacterial, Anticancer	[41]
9	Chinikomycins	*Streptomyces sp*	Anticancer	[42]
10	Bonactin	*Streptomyces sp.*	Antibacterial, antifungal	[43]
11	Abyssomicins	*Verrucosispora sp.*	Antibacterial	[44]
12	Erythromycin	*Saccharopolyspora erythrae*	Antibacterial	[45]
13	Rhamnose	*Saccharopolyspora spinosa*	Insect control agent	[46]
14	Zorbamycin	*Streptomyces flavovirdis*	Antitumor	[47]
15	Kanamycin	*Streptomyces kanamyceticus*	Antibacterial	[48]
16	Kanglemycin C (K-C)	*Nocardia mediterranei* 1747-64	Immunosuppressive	[49]
17	Rapamycin	*Streptomyces hygroscopicus*	Antifungal	[50]
18	Himastatin	*Streptomyces hygroscopicus*	Antitumor	[51]
19	Amphotericin B	*Streptomyces nodosus*	Antifungal	[52]
20	Rifamycin	*Amycolatopsis mediterranei* U-32	Antibacterial	[53]
21	Streptomycin	*Streptomyces griseus*	Antibacterial	[54]
22	Valinomycin	*Streptomyces griseus*	Mitochondrial toxin	[55]
23	Clorobiocin	*Streptomyces coelicolor*	Inhibit bacterial gyrase	[56]
24	Meilingmycin	*Streptomyces nanchangensis*	Antiparasitic	[57]
25	Duanomycin	*Streptomyces sp.*	Antitumor	[58]

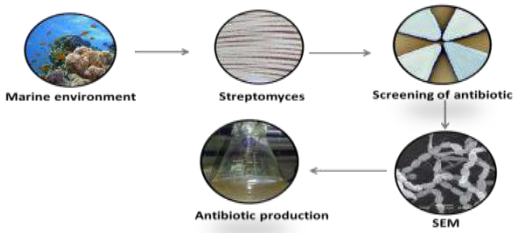

Figure 1: Antibiotics production from the marine environment

Figure 2: Morphology of *Streptomyces* sp

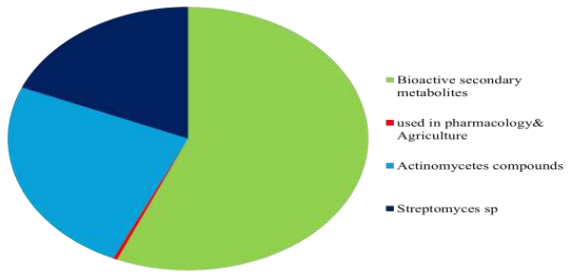

Figure 3: Apllications of marine environment

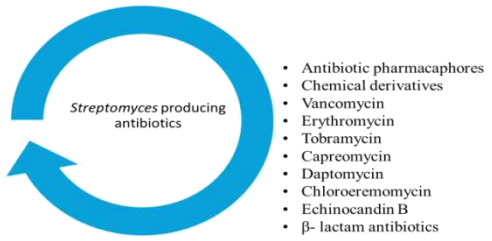

Figure 4: *Streptomyces* producing antibiotics classes

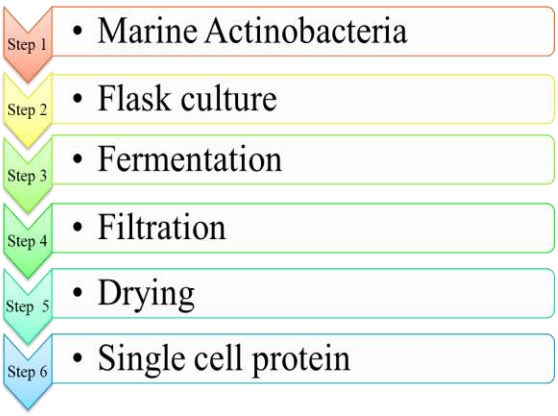

Figure 5: SCP Production

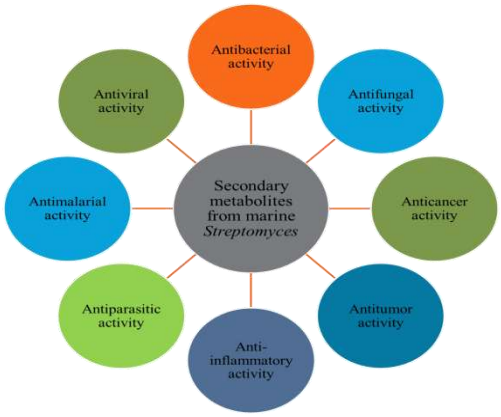

Figure 6: Secondary metabolites from marine actinomycetes

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REVIEW ARTICLE

A Review Literature of DHA Complexes

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ABSTRACT

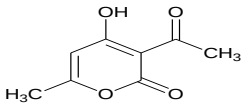
Dehydroacetic acid (DHA) and its straightforward variants have a wide range of uses in the production of heterocyclic compounds with biomedical promise.Dehydroacetic acid (DHA) has been treated with various hydrazines to produce binary and fused pyrazole ring structures. The theoretical model was used to conduct the geometric research densities functional theory (DFT).We summaries' here previous research work on the product lines based on the reaction of Dehydroacetic acid (DHA, 3-acetyl-4-hydroxy-6-methyl-2H-pyran-2-one, 1) and its derivatives in the biosynthetic pathways of heterocyclic compounds comprising Dehydroacetic acid (DHA, 3-acetyl-4-hydroxy-6-methyl-2H-pyran-2-one, 1) and its derivatives.DHA, a physiologically active molecule, has antibacterial and antifungal properties.

Keywords: (Dehydroacetic Acid)DHA, piperidine, IBD, dichloromethane, HTIB, heterocyclic compounds etc.

INTRODUCTION

Heterocyclic molecules have a chemistry that is as logical as aliphatic or aromatic ones. Their research is crucial from both a theoretical and a practical aspect. Heterocyclic compounds are found in abundance in nature as well as in a range of synthetic substances. Life requires a huge number of heterocyclic molecules. 'N' and 'O' heterocyclic systems can be found in a variety of substances, including alkaloids, antibiotics, vital amino acids, vitamins, haemoglobin, hormones, and many synthetic medications and colours. Biosynthesis and medication metabolism both benefit from understanding heterocyclic chemistry. Many synthesised heterocyclic molecules have other vital applications, and

many of them are useful intermediates in organic synthesis. In view of growing interest in the synthesis of heterocyclic compounds involving Dehydroacetic acid (DHA, 3-acetyl-4-hydroxy-6-methyl-2*H*-pyran-2-one, **1**) and its derivatives, we herein summarize literature work on the products resulting from the reaction of DHA and its derivatives. DHA, a biologically active compound, has shown to have good antibiotic and antifungal effects. It was isolated from natural sources and is now available in the industrial sector thanks to a variety of synthetic techniques. DHA and its derivatives have been demonstrated to have a wide range of applications in chemical synthesis. The research has been evaluated, as well as investigations on related pyrone derivatives.



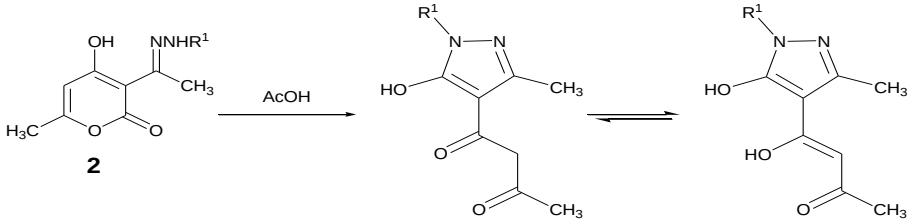
DHA, (1)

The carbonyl of the acetyl group, the carbon atom terminating the conjugated carbon at position-6, the lactone carbonyl, and the carbonyl carbon at position-4 are all vulnerable to attack by nucleophillic reagents since it has numerous reactive sites. An electrophile, on the other hand, can attack at C (3) or C (5). According to a review of the literature, reacting DHA and its derivatives with various reagents provides a flexible pathway to the synthesis of a wide range of heterocyclic compounds.. Since the studies embodied in this review are aimed at further exploring the potentiality of this aspect, it will be worthwhile to review the literature work concerning the synthesis of 'Nitrogen' and 'Oxygen' containing heterocyclic compounds from the reactions of DHA and its derivatives.

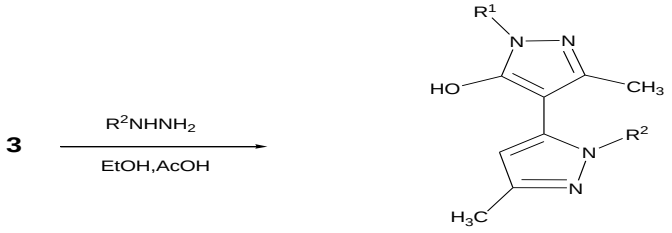
The heterocyclic compounds synthesized from dha and its derivatives are categorized as:

Pyrazoles And Bipyrazoles

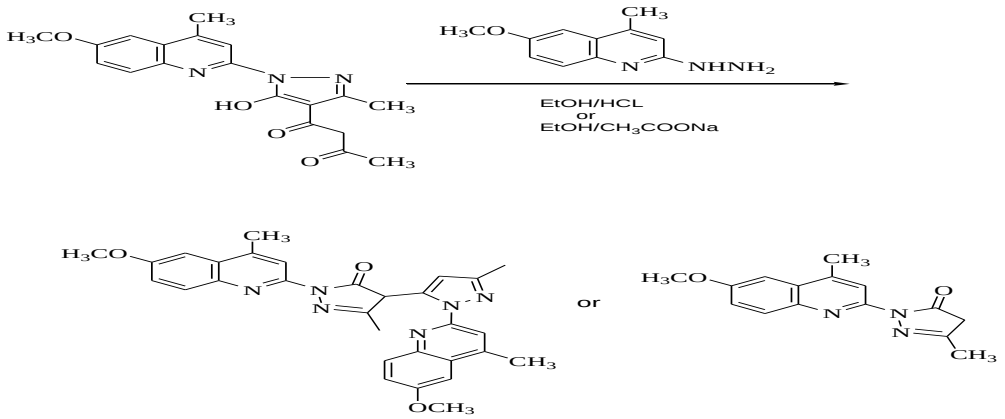
O' Connell and coworkers reported The intermediates and reactions of DHA with hydrazine have been isolated and identified. The production of hydrazones, which can then be separated and rearranged into 1-(5-hydroxy-3-methyl-1-substituted pyrazole-4-yl)-1,3-butanediones, is the first step.



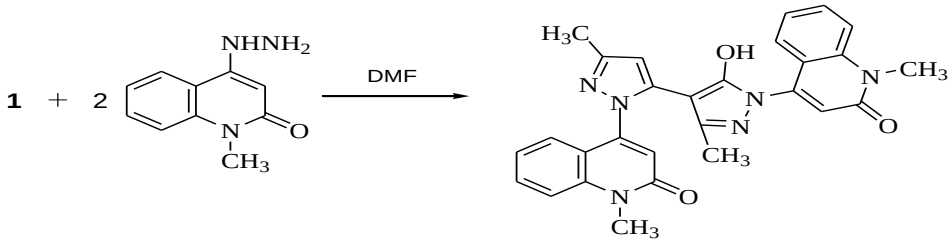
S P Singh *et al*, investigated that The condensation of 3 with hydrazines yields a single product, the bis-pyrazole 4, rather than a mixture of isomers.



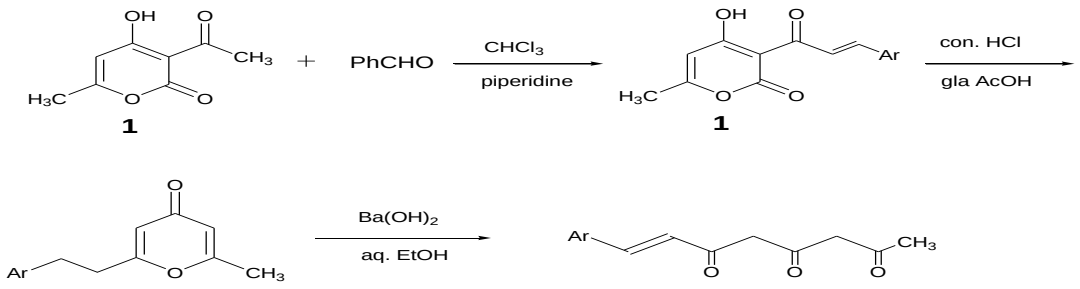
S P Singh and om parkas *et al*, While treating these compounds with ethanol/sodium acetate, an unprecedented reaction of 3 was seen in addition to the cyclization reaction leading to the synthesis of bipyrazoles. The reaction frequently results in the breakage of the c-c link, yielding two moles of 5-oxo-2-pyrazolines. The type of the hydrazine used in the second phase of the reaction appears to be the determining factor for the C-C bond cleavage, and the steric effect also appears to be crucial in the bond cleavage. When the reaction is carried out in ethanolic HCL, however, only bipyrazolyls are produced. Treatment of a representative molecule, 5(R1=4-methyl-6-methoxyquinolin-2-yl), generated via the rearrangement of 2, results in either cyclization to the matching bipyrazolyls (6) or C-C bond fission to generate 2 moles of 7.



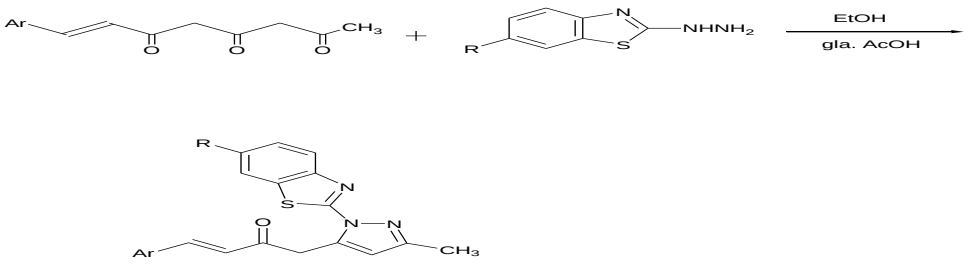
In their ongoing study on the bipyrazoles of DHA S P Singh *et al*, concluded that An intriguing bipyrazolylquinolone (9) is produced when DHA is treated with 4-hydrazino-1-methyl- (1H) quinolone (8) in DMF at a molar ratio of 1:2.



The pyrazolylbutane-1, 3-diones of type 3 are significant precursors for the synthesis of pyrazole-containing heterocyclic compounds. Vishwas Choudhary *et al*, synthesized 3-Cinnamoyl-4-hydroxy-6-methyl-2-oxo-2*H*-pyran (11) of DHA which can be rearranged in acid and rearranged product 12 on treatment with Ba(OH) 2, results in the formation of trione 13.

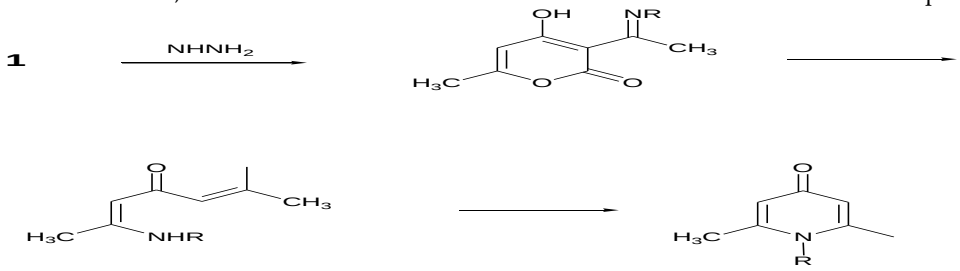


Trione (13) on treatment with various aryl oh hetryl hydrazines give pyrazoles.

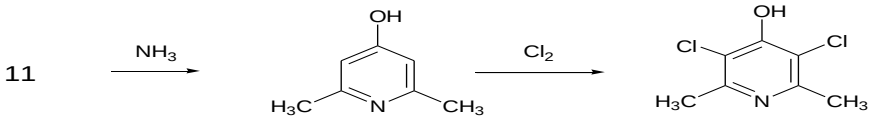


Pyridines

S Garratt *et al*, transformed DHA into pyridines 18 Ammonia and amines are used in the treatment. The intermediates 16, 17 have been isolated and identified after substantial research on this process.

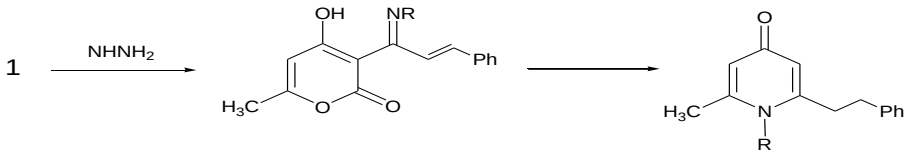


Z Zhang *et al*, Two-step reaction yielded 2, 6-Dimethyl-3, 5-dichloro-4-hydroxypyridine 20. DHA is treated with aq in this process. Ammonia produces the intermediate chemical 2, 6-Dimethyl-4-hydroxypyridine19, which is chlorinated to produce 20.



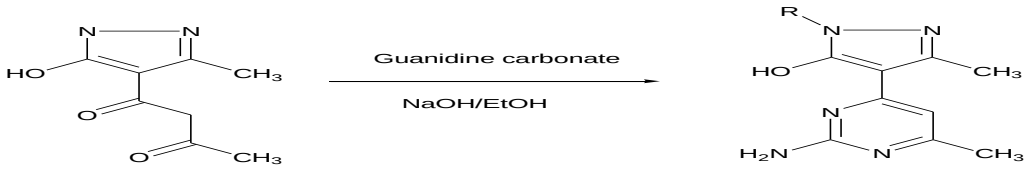
Pyridone

M Iqbaal *et al*, 3-Cinnamoyl-4-hydroxy-6-methyl-2H-pyran-2-ones11 and primary amines were used to make substituted-4-pyridones (22, R=H, CH3). The creation of Schiff's base 21 as the intermediate is a probable mechanism for this reaction.



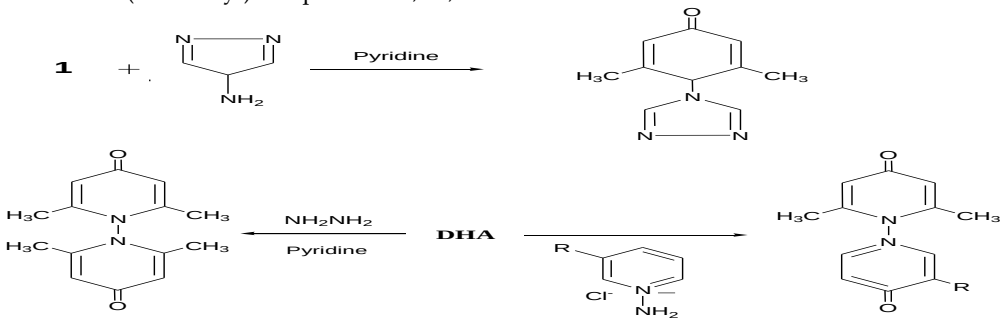
Pyrazolylpyrimidines

H Batra *et al*, synthesised Condensation of 4-acetoacetyl-5-hydroxy-3-methyl-1H-substituted pyrazoles 3 and guanidine carbonate in ethanolic NaOH yields 2-amino-6-methyl-4-(5-hydroxy-3-methyl-1-substitutedpyrazol-4-yl0pyrimidines 23. (40 percent). Some of these chemicals have been discovered to have mild antifungal activity.



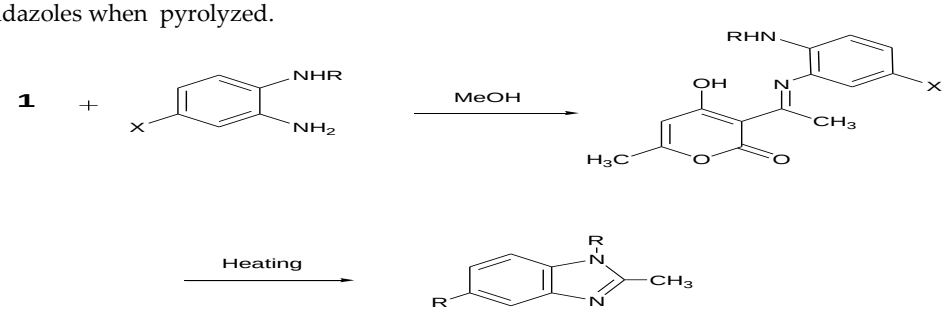
N, N'-LINKED BI(HETEROARYLS)

M P Sammesh and coworkers also synthesized N, N'-linked bi(heteroaryl) compounds by the reaction of DHA with aminotriazole. Many interesting versions of this reaction When hydrazine reacts with N-amino heterocycles, it produces. As a result of the reactions of DHA with aminotriazole24, hydrazine, and N-aminopyridinium salts 27, N, N'-linked bi(heteroaryl) compounds 25, 26, and 28 are formed.



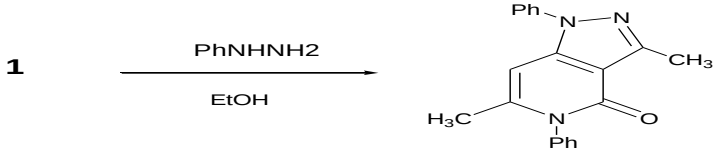
Benzimidazoles

M A Qayyoom *et al*, The reaction of substituted o-phenylenediamines 29 with DHA1 produces 3-[N-(substitutedo-aminophenyl) acetimidoyl] -4-hydroxy-6-methyl-2h-pyrones 30, which generate 2-methyl-5-substituted benzimidazoles when pyrolyzed.

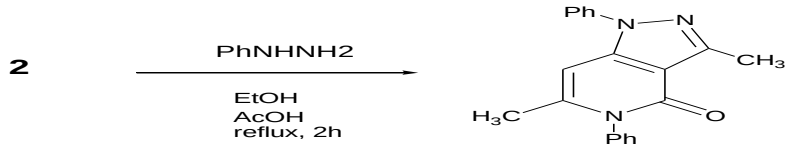


Pyrazolopyridones

K Ogawa *et al*, Two series of 3,6-dimethyl-1-phenyl-1H-pyrazolo[4,3-c] pyrazolo[4,3-c] pyrazolo[4,3-c] pyrazolo[4,3-c] pyrazolo[4, 3,6-dimethyl-1-phenyl-1H-pyrazolo [4,3-c] and pyridine-4-ones32 pyridine-4-thiones33 have been made with DHA as a starting material and tested in vitro for activity. The activity of the synthesised substances was compared to mirlinone, which was used as a control. Several of the substances have more potent inotropic action than mirlinone.



It's worth noting that heating hydrazones 2 in a mixture of ethanol and acetic acid has been reported to generate 1-aminophenyl-3,6,-dimethyl-4-oxo-1H-phenylpyrazolo[4,3-c]pyridine33. However, Gelin et al. conducted a re-examination of this data and discovered that the products acquired from this reaction were not as expected. are 3,6-dimethyl-1-phenyl-1H-pyrazolo[4,3-c]pyridine-4-ones 32 rather than 33.



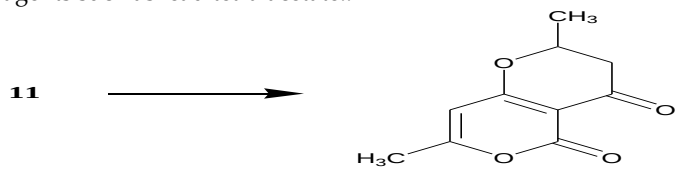
3-chloro-4-hydroxy-6-methyl-2-oxo-2*H*-pyran-2-one

Om Prakash *et al*, a human leukocyte elastate inhibitor, produced 3-chloro-4-hydroxy-6-methyl-2H-pyran-2-one (35) in 60% yield. DHA and its metabolite i.e. When 3-propionyl-4-hydroxy-6-methyl-2H-pyran-2-one is treated with a reagent made by adding POCl3 to a solution of IOB in DMF, the C-C bond is cleaved, and 35 is formed.

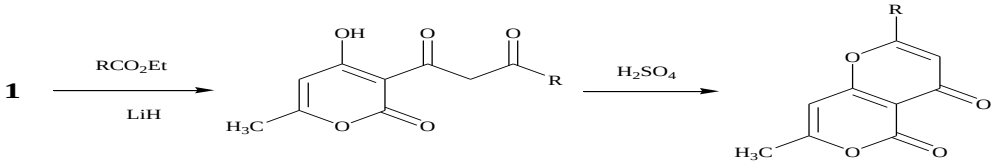
R= H, CH_3

Pyranopyrans

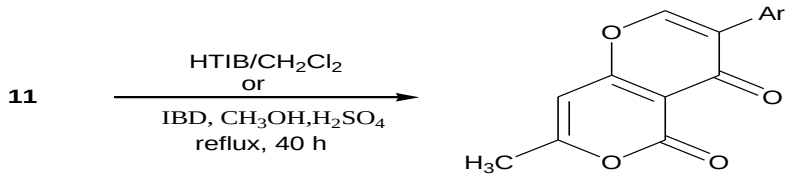
M Siddiqui *et al*, The synthesis of 2-alkyl-7-methyl-4H, 5H-pyrano [4,3-b]pyran-4,5-diones is reported. The manufacture of pyranopyrones is important from both a synthetic and biological standpoint. First, they make the flavanone analogue of DHA, 2,3-dihydro-2-alkyl-7-methyl-4H,5H-pyrano[4,3-b]pyran-4,5-diones, by condensation of DHA with aliphatic aldehyde in the presence of piperidine. The pyranopyran is obtained by dehydrogenating 2,3-dihydro-2-alkyl-7-methyl-4H,5H-pyrano[4,3-b]pyran-4,5-diones (flavanones analogues of DHA) with oxidising agents such as lead tetra acetate..



V Y Sosnovskikh and coworkers, Another method for the synthesis of pyranopyrans was described. In the presence of LiH in THF, treatment of DHA with esters RCO2Et yields -diketones of the type (3-acetoacetyl-4-hydroxy-6-methyl-2H-pyran-2-ones). 46. In the presence of cone, subsequent cyclization of 46. 2-Substituted-7-methylpyrano[4,3-b]-4H,5H-diones 47 are formed when H2SO4 is added.

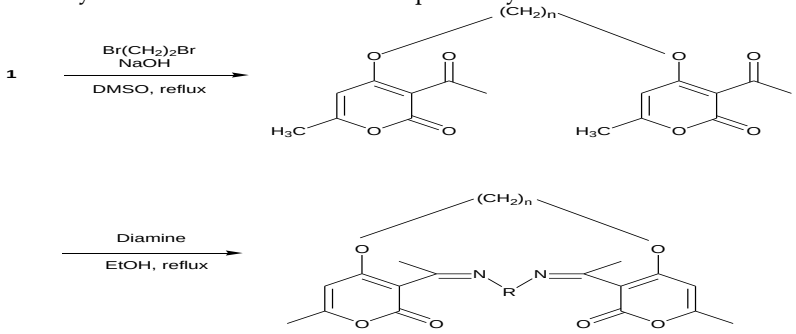


Om Parkash and co-workers, synthesized 3-aryl-7-methylpyrano [4,3-b] pyran-4H,5H-diones 53 (isoflavone analogue of DHA) by the oxidative rearrangement of 11 with 1.1 equivalent of HTIB [hydroxyl(tosyloxy)iodo]benzene, in dichloromethane.

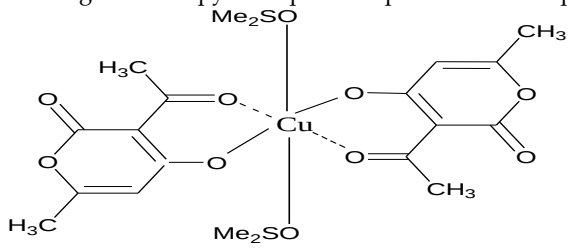


Formation of Metal Complexes

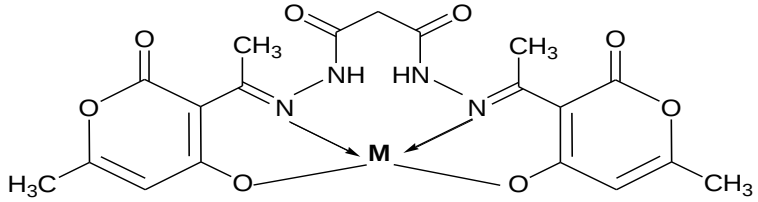
G S R Reddy *et al*,In a two-step reaction involving Williamson's condensation 54 and Schiff's base cyclization reaction with various demines such as 1,2- or 1,3-diaminoalkane, carbohydrazide, and thiocarbohydrazide, a new series of macro cyclic ligands with different ring sizes (14-, 15-, and 16-membered) are synthesised from DHA. These macrocycles' structures have been unequivocally confirmed..



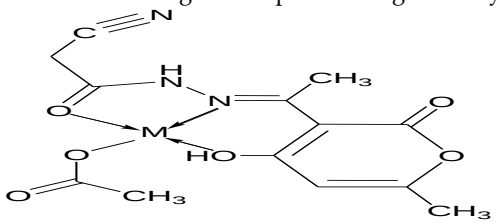
A djedouani *et al*, DHA is used to make bis-[3-acetyl-6-methyl-2h-pyran-2,4(3h)-dinato] bis-(dimethylsulfoxide) copper(ii). The dimethylsulfoxide (DMSO) ligands are weakly coordinated through their O atoms, and the bidentate DHA ligands occupy the equatorial plane of the complex in a trans configuration.



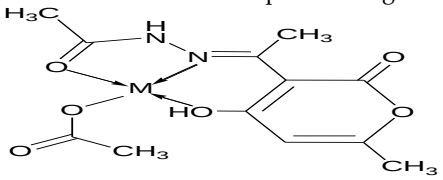
R. P. saini *et al*,Cu (II), Ni (II), CO (II), Mn (II), and Zn (II) were used to create a new series of Schiff's base complexes (II). The tetradentate Schiff's base is made by reacting malonyl hydrazide with dehydroacetic acid in methanol while it is refluxing. When compared to the standard medication Ampicillin, all of the produced compounds were tested for antibacterial efficacy against gram-positive and gram-negative microorganisms.



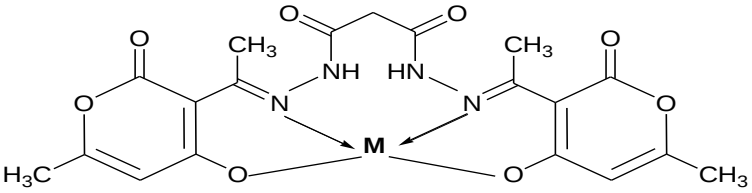
R. Pal *et al*, Co(II), Ni(II), Cu(II), Mn(II), and Zn(II) coloured metal complexes with hydrazone Schiff's base produced by condensation of dehydroacetic acid and cyanoacetic acid hydrazide were described. All of the compounds were shown to have high DNA photoclevage activity.



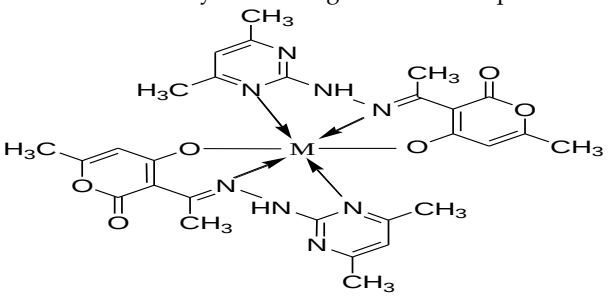
R. P. Saini *et al*, identified a new family of tridentate hydrazone Schiff bases based on dehydroacetic acid and their colourful complexes with Co(II), Ni(II), Cu(II), Mn(II), and Zn (II). The condensation reaction between acetic acid hydrazide and dehydroacetic acid yielded the hydrazone Schiff base. Using plasmid DNA, all produced compounds were evaluated for DNA photoclevage activity.



R. P. Saini and coworkers, Under solvent-free conditions, an unique series of metal complexes of Cu(II), Ni(II), Co(II), Mn(II), and Zn(II) were synthesised with a tetradentate N,N'-bis(1-(4-hydroxy-6-methyl-2-oxo-2H-pyran-3-yl)ethylidene)malonohydrazide Schiff's base. In a preheated mortar at 80 °C, the ligand and suitable metal salt mixture was ground continuously for 3-6 minutes. In the presence of 40 g, a DNA photoclevage experiment was carried out with produced chemicals in a volume of 10 l containing plasmid DNA in TE (Tris, 10mM, EDTA 0.01mM, pH 8.0) buffer. Cu(II) complex, as opposed to ligand and other created metal complexes, operates as a possible nuclease agent among all the synthesised molecules.

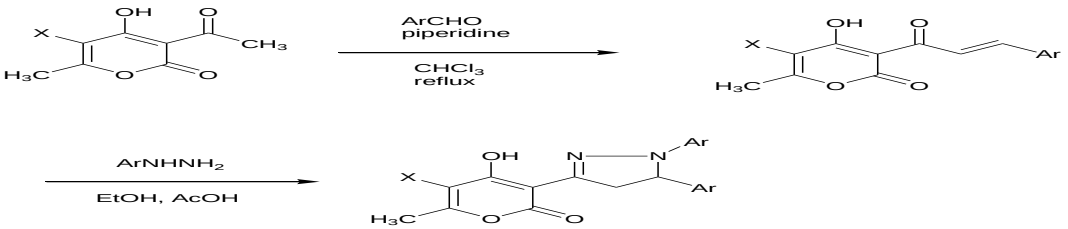


S. Saini *et al*, Cu(II), Ni(II), Co(II), Mn(II), and Zn(II) tridentate Schiff's base complexes were produced. The Schiff's base is produced by refluxing 2-hydrazino-4,6-dimethyl pyrimidine with dehydroacetic acid (DHA) in ethanol. The produced substances were tested to see how effective they were. DNA photoclevage activity using plasmid DNA, and it was found that all the compounds are good DNA photo cleaving agents. The compounds also possess good antibacterial activity than the ligand when compared with the standard drug *Oxacillin*.



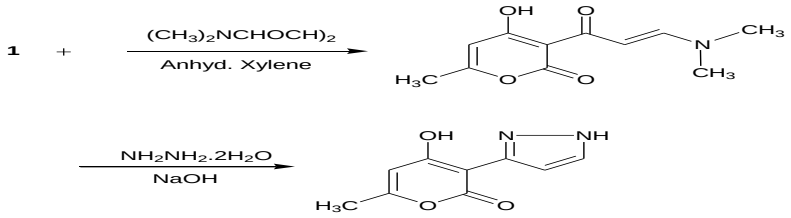
Pyranylpyrazolines

R.H. Wiley and coworkers, synthesized 3-cinnamoyl-4-hydroxy-6-methyl-2*H*-pyran-2-ones by the reaction of DHA with aromatic aldehyde 11. V. K. Mahesh *et al*, reported that 3-cinnamoyl-4-hydroxy-6-methyl-2*H*-pyran-2-ones on treatment with aryl hydrazines (Ar-NHNH$_2$) in EtOH-AcOH gives the1,5-diphenyl-3-(4-hydroxy-6-methyl-2H-pyran-2-one-3-yl)-2-pyrazolines.Some of these chemicals have exhibited antifungal efficacy against Pyricularia oryzae, the rice plant's blast fungus. 1,5-diphenyl-3-(5-bromo-4- hydroxy-6-methyl-2H-pyran-2-one-3-yl)-2-pyrazolines can be synthesised using the same method.

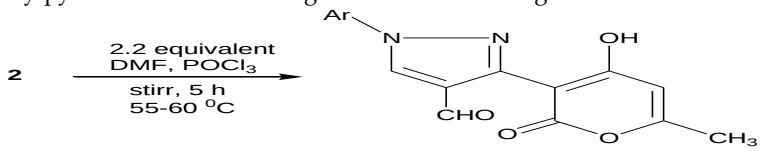


Pyranopyrazoles

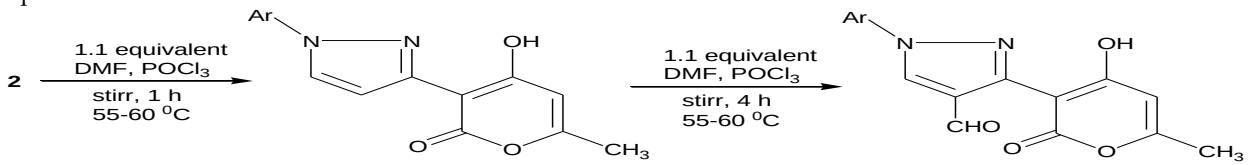
W. Lowe *et al*,On condensation of DHA with N,N-dimethylformamide dimethylacetal and treatment with NH2NH2, 4-hydroxy-6-methyl-3-[3-dimethylaminoacryloyl]-2H-pyran-2-one was produced. The cyclization is catalysed by 2H2O, yielding 3-[4-hydroxy-2-oxo-6-methyl-2H-pyran-3-yl]. pyrazole60.



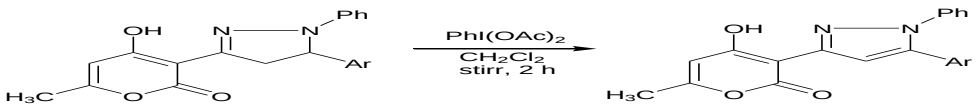
A. Kumar and his coworkers synthesized some novel 4-formyl-3-(4-hydroxy-6-methyl-2-oxo-2H-pyran-3-yl)-1-arylpyrazoles 63 from 2 using Villsmeier-Haac reagent.



A. Kumar *et al*, It was also reported that utilising 1.1 equivalents of POCl3/DMF, the intermediate 64 could be synthesised. When the hydrazones are cyclized using standard Villsmeier-Haac conditions, that is, by stirring the mixture (2.2 equivalent of POCl3/DMF) at 55-60 0C for 4-5 hours, the reaction produces the predicted 4-formyl analogue63. Alternatively, the products 63 can be produced by formylating 64 using Villsmeier-Haac reagent 1.0 equivalent.



Om Parkash *et al*,pyranyl pyrazolines 58 were oxidised in dichloromethane using the oxidising agent iodobenzene diacetate (IBD), yielding 1,5-diaryl-3-(4-hydroxy-6-methyl-2-oxo-2H-pyran-3-yl)-2-pyrazoles 65.



CONCLUSION

Finally, chemically described novel cobalt dicyanamide compounds with nitrogen-containing heterocyclic cross were produced. We created a new class of more these chalcones and tested them for antibacterial activity. As a result of the findings, chemicals were shown to be the most efficient against all microorganisms examined. In addition, the conjugated carbonyl region was changed to isoxazoline, pyrimidines, pyrazoles, and cyanopyridine. Based on the antibacterial activity of these changed components, it was determined that (nitro containing pyrazole) is an effective antibacterial inhibitor. The observed results demonstrates that several of the examined substances have exceptional to moderate in vitro bioactivities.

ACKNOWLEDGEMENTS

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RESEARCH ARTICLE

Design and Simulation of Standalone PV System using PV SYST

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ABSTRACT

The load demand is increasing rapidly nowadays so that conventional energy source cannot meet the demand. For that, renewable energy source is the best appropriate choice which is a non-conventional energy source. In that renewable energy source, solar energy is abundant in nature and it can be installed everywhere whether there is sunlight, without getting permission from the government for standalone system. Solar panel output power delivers maximum power at some particular value of voltage and current. This point is called as Maximum Power Point, at this point solar panel absorbs maximum amount of sunlight but it doesn't deliver constant maximum power for all the time because the solar output power depends upon the temperature and solar irradiance which may vary time to time according to sunlight direction. To get a maximum power, Maximum power point tracking is an orientation system which tracks sunlight according to its direction. Before constructing solar photovoltaic system, several modelling software are used to determine the approximate losses and power generated from it. Among the different types of solar PV system software, solar PVsyst software is the best one having additional features like meteorological data which is used for designing it more efficient. In this paper, the simulation of standalone PV system using solar PVsyst software has been discussed in detail.

Keywords: Load Demand, Maximum Power Point Tracking, Renewable Energy Source, Standalone system, Solar Panel.

INTRODUCTION

There is no common grid to supply power to the entire country. All the power plant requires some kind of source to produce electricity. But the source is not available everywhere. Each power plant requires unique source which should be available in some unique place. For example, if we consider hydro power plant, it should be located near to dams. Likewise, there are so many power plants in India but solar power plant has the specialty to grab the energy from the sun and convert it into light energy [1] so that it is a renewable as well as non-conventional source of energy. Solar power plant is constructed wherever sunlight is there. So that the implement of solar power plant in rural areas create more comfort to the people. In PVsyst software various details should be entered according to our needs. After running the simulation, graph between various parameters are shown which is very useful for better understanding and good installation.

PROCEDURE FOR STANDALONE PV SYSTEM

Geographical Sites Parameters

In this, it by default shows the place of Geneva, Switzerland where the place this software is developed [2]. It is like a map when once selecting new site it shows the locality, country, latitude, longitude, altitude and time zone. After accept selected point it shows graph between the Azimuth angle and sunlight. Then it shows monthly meteorological data for the site which includes global horizontal irradiation, horizontal diffuse irradiation, temperature, wind velocity, linke turbidity and relative humidity in Fig. 1. After exporting meteo site, all data about the sites will move on to main project file directory [3]. Here, Kallakkurichi district has been chosen as the new site for constructing standalone PV system in Fig. 2. Fig 1 (a) and (b) represents the synthetically generated data from monthly values and solar path at kallakurichi district. Fig. 2 represents the interactive map for choosing kallakurichi site in Indian map.

Location: Kallakkurichi, Tamil Nadu, India,
Latitude: 11.7383
Longitude: 78.9644
Altitude: 121m above sea level
Time Zone: (UTC +5:30), Chennai

ORIENTATION

In this orientation, the tilt angle and the azimuth angle can be set according to sun path for maximum efficiency of solar panel [4]. The graph for both angles is shown in Fig. 3. Fig. 3 represents the horizontal and vertical orientation of solar panel with quick optimization.

USER NEEDS

It requires data about the wattage of the specific appliances; specify hour adjustment, number of individual appliances used and hourly distribution [5]. Finally, it shows power consumption for the annually or monthly as a report. The monthly power consumption can be modified differently according to different month[6-7]. Here, daily household consumption for a typical home has been chosen in Fig. 4. Finally, total daily energy is 133KWh/day and the Monthly energy is 3997KWh/month. Fig. 4 represents the hourly distribution of each and every load within specify hours.

Battery Management System

In this system, it shows the average daily needs expressed in kwh/day as per user needs [8], percentage of PLOL (Probability Loss of Load) and requested autonomy which indicates number of days that the battery delivers energy to the load if one time charged. It includes storage, new collector array, back up genset and simplified sketch. In this storage, fixed temperature and the type of battery can be used then according to it shows battery capacity like battery voltage and battery capacity in mAh [9]. After choosing battery voltage its shows number of batteries in series and in parallel. Then move on to new collector array which includes number of modules are in series or in parallel, types of solar panel used, operating mode which may be direct coupling, MPPT (Maximum Power Point Tracking) and DC to DC converter for the efficiency of the system. And Maximum Power Point Tracking is preferred

for more efficiency [10-11].

Average Daily needs : 133KWh/day Enter Accepted PLOL : 5.0%
Enter Requested Autonom : 2.0 days Battery (user) voltage : 48V
Suggested Capacity : 6532Ah
Suggested PV power : 42168W

Fig. 5 represents the graph between normal PV power and PLOL with sizing parameters and sizing results. Last there will be simplified sketch which shows connection diagram in Fig. 6. Fig. 6 represents the layout of standalone PV system which includes PV array, back-up generator, batteries, Inverter and load.

CALCULATED LOSSES

It includes thermal parameters, ohmic losses, module quality-LID-Mismatch- soiling loss, IAM losses and spectral correction [12-14]. While doing the above procedure detailed losses should be automatically predetermined using algorithm. Thermal loss factor $U=U_c+U_v$ where U_c is constant loss factor and U_v is Wind loss factor [15]. Fig. 7 represents the IAM losses according to incidence angle of solar panel. Fig. 8 represents the calculated loss for entire system for entire year in all regions. In this loss diagram, the major loss of energy is due to unused energy of 47.67% loss. And the loss for each and every explained in detail.

SIMULATION RESULTS AND DISCUSSION

Software Resultant Graph

After completing all those all those above things, simulation is ready to run in Fig. 9. It shows graph between the various parameters for better understanding and good installation in Fig. 10. After completing simulation run it also shows economic evaluation [16-17]. Fig. 9 represents the overall view of simulation of standalone PV system in PVsyst software. Fig. 10 represents the entire graph between various parameters from the starting of geographical parameters to ending of calculated losses[18].

MPPT ALGORITHM

The simple method MPPT algorithm is Perturbation and Observation Algorithm. It is cost effective and easy to implement. It perturbs continuously the operating voltage when after comparing output power with its previous value [19-20]. Fig. 11 represents the perturbation and observation of maximum power point algorithm.

CONCLUSION

In India, one of the world largest solar power plants is located in Kamuthi, Ramathanapuram district, Tamil Nadu. It covers 2,500 acres of land to produce power of capacity 648MW (megawatt). Tengger desert solar park is the world largest solar power plant of capacity 1547 MW. Each individual person can install solar panel to their homes to meet their load demand. Solar energy is not a saturated area and it is emerging technology with new inventions. In this PVsyst software, simulation of standalone PV system is discussed for the implementation of new PV system and the losses are calculated based upon the needs.

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Table 1. Monthly meteo data for Kallakurichi

	Global horizontal irradiation (kWh/m²/mth)	Horizontal diffuse irradiation (kWh/m²/mth)	Temperature (^{0}C)	Wind velocity (m/s)	Linke turbidity	Relative humidity (%)
January	179.2	49.1	25.0	1.70	4.335	76.4
February	172.8	57.0	26.2	1.51	4.383	73.8
March	198.2	76.1	28.2	1.40	5.117	73.4
April	194.5	83.2	29.7	1.50	5.518	75.5
May	176.6	93.5	31.1	2.10	6.401	69.0
June	131.3	87.2	30.4	2.50	4.843	66.4
July	139.1	86.9	30.3	2.40	5.165	65.9
August	151.1	88.9	29.9	2.20	4.907	68.5
September	147.5	75.3	28.8	1.70	4.579	74.4
October	154.1	79.5	27.8	1.30	5.323	77.8
November	139.7	70.3	25.7	1.50	4.796	83.7
December	165.2	54.8	25.0	1.80	4.651	79.7
Year	**1949.3**	**901.8**	**28.2**	**1.8**	**5.002**	**73.7**

Table 2. Power consumption of each household appliance

Number	Appliance	Power	Daily use (hr/day)	Daily energy (Wh)
7	LED Lamps	20W/lamp	4	560
1	Television	50W/app	3	150
1	Domestic Appliances	500W/app	0.5	250
1	Fridge	131KWh/day	24	131000
3	Fan	70W/app	6	1260
			Energy per day	**133244 Wh/day**
			Monthly Energy	**3997.3 KWh/month**

Table 3. Storage and PV array for the system

Sort Batteries by	Voltage	**Battery Pack Voltage**	48V
Type of battery	Lead Acid Battery	**Global Capacity**	6549Ah
Name of the Company	Exide Classic	**Stored energy (80% DOD)**	251KWh
Batteries in Series	4	**Total Weight**	9629 Kg
Batteries in parallel	177	**Fixed temperature**	25^{0}C
Number of Batteries	708	**Total stored energy during the battery life**	223MWh
Operating mode	MPPT Converter	**Modules in series**	1
Area	267m²	**Number of strings**	108

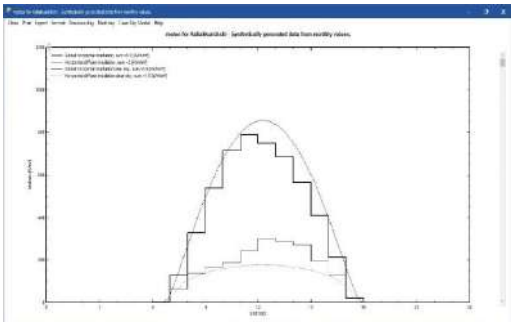

Fig. 1 (a) Graph among the geographical parameter

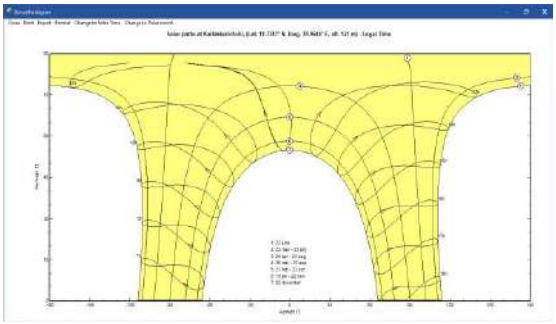

Fig.1 (b) Graph between sunlight and azimuth

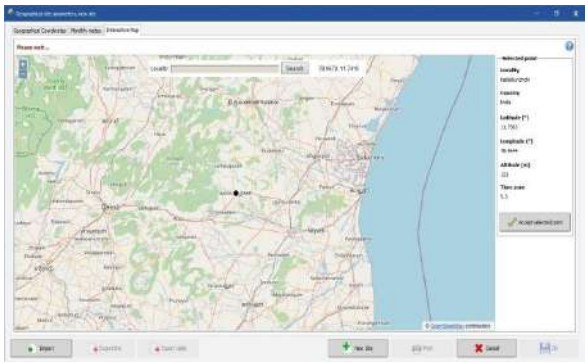

Fig. 2 Interactive map for Kallakurichi

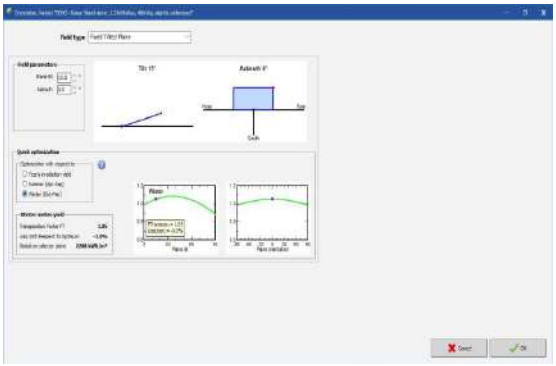

Fig. 3 Orientation of Solar Array

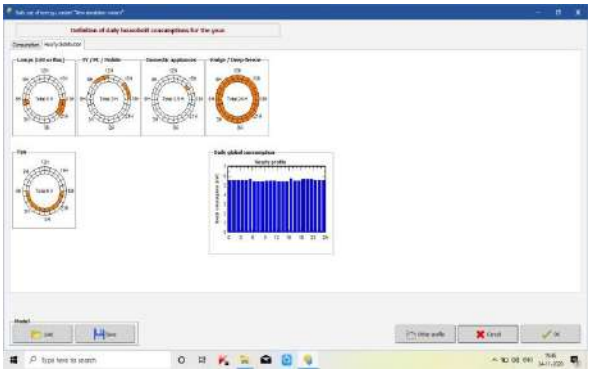

Fig. 4 Hourly Distribution of home appliance

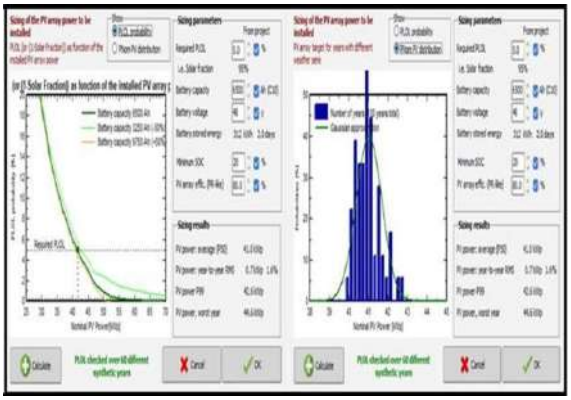

Fig. 5 Graph between Normal PV Power and PLOL

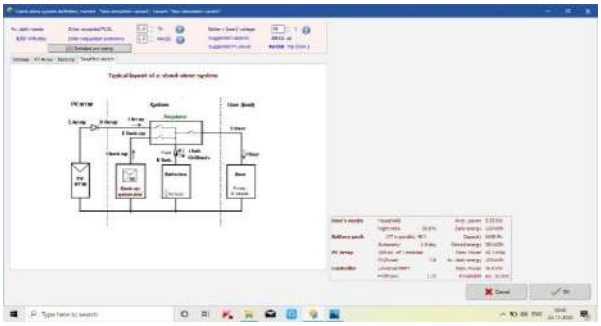

Fig. 6 Typical layout of standalone system

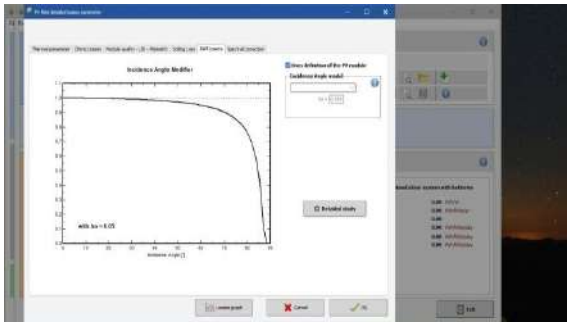

Fig. 7 Incidence angle modifier loss

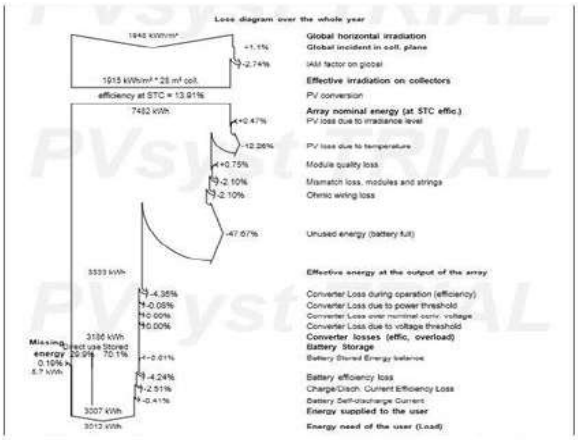

Fig. 8 Loss diagram over the whole year

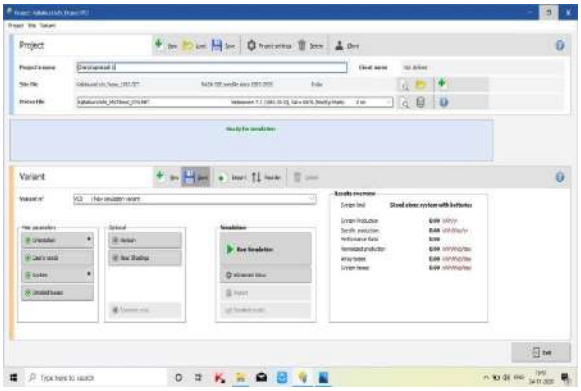

Fig 9. Simulation of standalone system

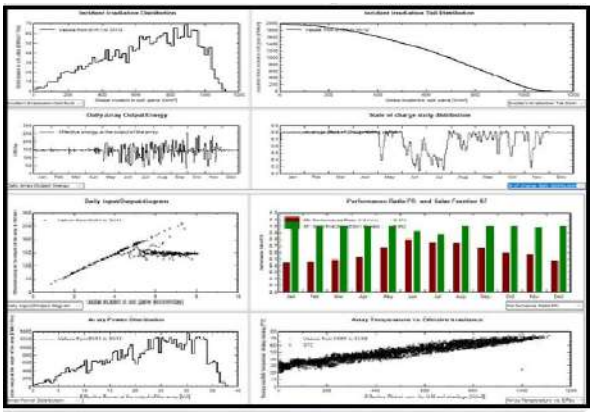

Fig.10 – Graph between various parameters

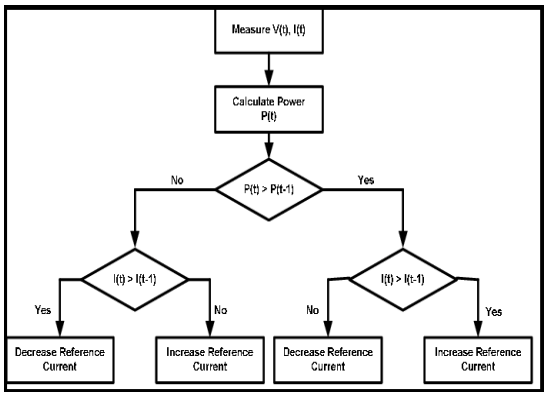

Fig.11. MPPT algorithm

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RESEARCH ARTICLE

Impact of Russia-Ukraine War on Auto Mobile Sector of India: An Event Study

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ABSTRACT

Russia's decision to invade Ukraine has a variety of implications on the Indian auto and mobile industry as the global supply chain is once again put under strain. The war will have a negative effect on economic prospects. This paper analyses the impact of Russia and Ukraine war on Indian stock exchange and selected automobile sector companies such as Bajaj Auto, TVS Motors, Eicher Motor, Hero Moto Crop, Maruti Suzuki, Force Motors, M&M, Ashok Leyland, Escorts Limited, and Tata Motors. To achieve the purpose of this paper event study has been used. The findings of this paper suggest that all the automobile companies significantly responding to the event. Only Bajaj Auto showing the positive trend with positive CAR while all other companies are the worst affected with negative CAR. The result of this study would be useful for the investors, traders and police makers. Further the investors can plan investment strategy accordingly.

Keywords: Russia-Ukraine war, supply chain, Event study, event, stock exchange.

INTRODUCTION

The war between Ukraine and Russia worsens the shortage of semiconductor as both the countries manufacture some of the major components for producing chips. The auto mobile sector of India suffers various consequences because of the decision of Russia for invading Ukraine as the supply chain globally is under strain once again. The (FADA) Federal Association of Automobile Dealers Association found that the war will affect negatively the outlook of industry. The vision is converted from neutral or normal to negative till the war conclude. The recent reports shows that the largest producer of the metals extracted from rare-earth especially Palladium is Ukraine. This metal is essential for the semiconductors. Another largest exporter and producer of Neon gas is Ukraine that is used for the purpose of manufacturing the semiconductors. This war will bring a lot of challenges in the auto retail sector of India. Even before the beginning of war, the industry of semiconductors witnesses global slump. The largest automobile producer of the country is Maruti Suzuki and even they face the drop of 2% in the total manufacture of the last quarter of December, in comparison with the previous years. This similar trend was detected in the total manufacturing of other automobile maker like Hyundai, Tata Motors and Honda cars. This war impacts the prices of Neon gas and the prices increased by 10 times, which affects the automobile manufacturing in India and Asia-Pacific region. These instances extend the delivery, sales and production of automobiles. The new production of trucks and cars also hit in millions because of the war. The supply of raw material was delayed which directly reduced and delayed the production of automobiles in India and other dependent countries. This war reduced the production of vehicles in the last year, public faces a long escalating and waiting periods. Technically, internal combustion engine needs semiconductors for their production. The prices of crude oil were also spiked due to the crisis and it potentially push up the cost of domestic fuel.

Review of literature

The disputes between Russia and Ukraine have been started long years ago**.** It is obvious that the current conflict is a result of the common histories of the both nations. The present war between Russia and Ukraine had begun on the 24th of February 2022.This war has had an effect on the world economy, generating high inflation and slower growth because Russia and Ukraine are significant producers of oil and other goods that together account for 30% of global export (Nazeeruddin, 2022).Russia exports more wheat than any other country in the world, and Ukraine exports more grains overall(Dr. B. Nagarjuna, 2022.).Due to this conflict, the price of oil has climbed by 10%, GDP growth is expected to slow by 20 percentage points, and inflation has risen by 40%, which are the causes of the current account deficit (Dr.Manjushree, 2022.).various study revealed that there is a negative impact of the war among the Russia and Ukraine on different countries stock market.(Yousaf et al., 2022.)examined the impact of Russia and Ukraine conflict on the stock market of G20 countries with the help of event approach and revealed that majority of the stock markets are negatively affected by Russia-Ukraine conflict. This war has major impact on financial market of all countries. Due to this the stock market of whole world showing down wards trend continuously.(Doğan, 2022.)employed an event study and one sample t-test to analyse the abnormal returns of 209 companies. They discovered that on the first day before the conflict, the companies' average abnormal returns and cumulative abnormal returns were positive, whereas on the second, third, fourth, and fifth days, the average abnormal returns and cumulative abnormal returns of the companies were negative as a result of the conflict.

Every war has a negative effect on important economic sectors around the world, and the automobile industry is the largest economic sector that was adversely affected by this conflict (Chintan, 2022.). The auto sector was principally affected by 4 different types of problems: The major problems are interruptions in production, decline in demand for fuel-powered vehicles due to rising fuel prices, an uncertain raw material supply and Disruptions to export and import imposed on by travel restrictions and sanctions (Chakkoria, 2022.).

Objective

The purpose of this study is to measure the impact of Russia and Ukraine wore on national stock exchange of India and some selected companies of automobile sector in India. Hence, an attempt to answer the following questions is made.

1. Did the selected automobile companies' returns show any significant response to the conflict between Russia and Ukraine?
2. Did the selected automobile companies' returns respond in a similar manner to the conflict between Russia and Ukraine?

DATA AND METHODOLOGY

Data

The present study includes the daily stock prices of Top 10 Automobile companies registered on NSE. Daily closing price of each selected company's has been taken from 5 august 2021 to 11 March 2022 for the analysis purpose. Nifty 50 is taken to be used as market proxy. The data has been obtained from the NSE official website and yahoo finance website. Table 1 gives the list of selected companies from the Automobile sector.

Event study Methodology

Ball and brown; Fama and Fisher has proposed the event study methodology to assess the impact of any event or any announcement on the financial market performance. Given fact that the market is rational, the effect of any event will be reflected in stock prices of the related firm within a very few times period. Thus, using the security prices observed a very short time period the economic impact of any event can be seen on the value of firm (Mackinlay, 1997).This methodology has been used in numerous research to examine how unexpected conditions affect the stock market (Maneenop & Kotcharin, 2020, Yousaf et al., 2022, Mackinlay, 1997)

In this paper, the impact of Russia and Ukraine war on the companies of Automobile sector in India has been studied using event study methodology. The first step of this methodology is to define the event day of interest. The war between Russia and Ukraine was started on 24 February 2022, hence 24 February is considered as event day for the purpose of this study. And the next step of this methodology is to determine the estimation window for calculating expected return and event window to see the effect of the event. As suggested by the previous studies, estimation window should be long for the purpose of accuracy so a window of 128 trading days just before the event window has been taken so that estimation window could not be overlapped with event window. And a window of 10 trading days before the event and 10 trading days after the event has been taken to see the immediate impact of war between Russia and Ukraine. Figure 1 clearly illustrates the timeline of selected window.

In accordance with the event study approach, there will be abnormal returns immediately following the occurrence of the event or announcement if the event has any impact on the stock price. The discrepancy between a return's actual value and its predicted value during an event window is known as an abnormal return. Firstly, the daily returns of each company are calculated by daily closing prices for the estimation window and the event window.
The expected return for the event study is calculated based on market model, which relates the security returns with market returns. Through this market model, parameters for calculating expecting return are identified in the estimation window. The market model is written below:

$$R_{i,t} = \alpha_i + \beta_i R_{m,t} + \varepsilon_{i,t} \quad (1)$$

Where $R_{i,t}$ are the return for the stock I and R_m, t are the market returns on day t within the estimated window, with $\varepsilon_{i,t}$is an independent and uniformly distributed residual of stock I at time t.

After determining α_i and β_i the expected returns for the stock return I on day t is estimated as

$E(Ri,t) = \alpha i + \beta i\ Rm,t$ (2)

After that following formula is used to calculate Abnormal returns

$ARi,t = Ri,t - E(Ri,t)$ **(3)**

To adjust the uncertainties around the event day, abnormal returns are accumulated for each company across the event window.

$CAR(t,t+k) = \sum Ari,t+k$ (4)

RESULT AND INTERPRETATION

The graphical representation gives a rough idea of data. By having a look at the following figure 2, one can have an idea about the impact of Russia and Ukraine war on the companies of Automobile sector in India. All the companies stock returns along with NIFTY 50 has dropped down on day 0 (24-02-2022). NIFTY 50 has dropped by 5%. Further, the stock price of all the selected companies of Auto sector such as Tata Motor, TVS Motors, Eicher Motors, Hero MotoCorp, Bajaj Auto, Maruti Suzuki, Escorts Limited, Force Motors, Mahindra & Mahindra, Ashok Leyland fell by -11%, -5%, -3%, -7%, -3%, -6%, -4%, -6%, -7%, and -9% respectively. Thus, it is clearly apparent that there is a negative impact of Russia and Ukraine war on stock price of Indian auto sector companies.

Table 2 provide the selected companies AR during the event window (-10, 10Before the war began, all the companies showed mixed results (positive and negative AR), with TVS Motors, Force Motors, Ashok Leyland, and Tata Motors showing negative AR on the majority of the days. Other examples include Eicher Motors, which showed negative AR only on day -4, Hero MotoCorp, which showed negative AR on days -4 and -3, Bajaj Auto, which showed negative AR on day -3, Maruti Suzuki, which showed negative AR on days -8 and -10, Only three of the 10 selected companies display favourable AR on the event day, while the other companies displayed negative AR. After event day most of companies shows negative AR which represent that war between Russia and Ukraine war affects the Automobile sector of India.

The figure 3 represents the overall picture of automobile companies' performance during the entire event window. As we can see, only Bajaj Auto exhibits an upward trend and a positive CAR at the tenth day of 1%, indicating that investors have trust in the company's shares. While all other businesses, including TVS Motors, Eicher Motor, Hero Moto Crop, Maruti Suzuki, Force Motors, M&M, Ashok Leyland, Escorts Limited, and Tata Motors, exhibit a declining trend with negative CAR at the tenth day (-12%, -7%, -11%, -23%, -3%, -10%, -20%, -8%, and -16%). This demonstrates unequivocally how the conflict between Russia and Ukraine influences investors in the auto and mobile sectors' investment decisions.

CONCLUSION

This paper aims to analyse the effects of the war between Russia and Ukraine on the Indian automobile sector by looking at the performance of ten selected auto companies: Tata Motors, TVS Motors, Eicher Motors, Hero MotoCorp, Bajaj Auto, Maruti Suzuki, Escorts Limited, Force Motors, Mahindra & Mahindra, and Ashok Leyland within the first ten days of the conflict. It uses the event study technique that (MacKinlay, 1997) outlined. The outcome suggests that the conflict between Russia and Ukraine has an impact on India's automobile industry. With the exception of Bajaj Auto, all of the automobile industry's chosen corporations made a substantial response to the war event. At the event, it demonstrated a positive AR. All others had negative AR on the day of the event. However, there are substantial differences in how they react to Russia and Ukraine war event. All the companies

except Bajaj Auto shown decreasing trend with negative CAR, including TVS Motors (-12%), Eicher Motor (-7%), Hero Moto crop (-11%), Maruti Suzuki (-23%) and Tata Motors (-16%). Only Bajaj Auto saw an upward trend with a 1% positive CAR. Thus, this study's findings demonstrate that the conflict between Russia and Ukraine had a major impact on investors' attitudes and behaviours, which led to notable abnormal returns.

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Table 1: Description of selected Automobile companies

NAME OF COMPANY	NAME OF COMPANY
1. Ashok Leyland	6. Hero MotoCorp
2. Bajaj Auto	7. Maruti Suzuki
3. Eicher Motor	8. Tata Motors
4. Escorts Limited	9. TVS Motors
5. Force Motors	10. Mahindra and Mahindra Limited

Table 2: AR of selected Auto Mobile companies During Event Window (-10,10)

Event Days	TVS Motors	Eicher Motor	Hero MotoCorp	Bajaj Auto	Maruti Suzuki	Force Motors	M&M	Ashok Leyland	Escorts Limited	Tata Motors
-10	1%	0%	0%	0%	-2%	-1%	1%	-2%	-1%	0%
-9	-1%	0%	0%	1%	0%	0%	1%	-1%	0%	0%
-8	-1%	2%	0%	0%	-2%	-4%	-1%	-4%	-1%	-1%
-7	2%	3%	3%	1%	1%	-1%	1%	0%	-1%	1%
-6	0%	0%	0%	0%	0%	2%	1%	0%	1%	-1%

-5	1%	1%	0%	0%	0%	-2%	0%	-1%	0%	0%
-4	-1%	-1%	-1%	1%	0%	1%	-1%	0%	0%	-1%
-3	-1%	0%	-2%	-1%	1%	-2%	-1%	-1%	0%	1%
-2	1%	2%	1%	1%	0%	-3%	2%	0%	0%	-2%
-1	-2%	0%	-2%	0%	1%	3%	0%	0%	0%	0%
0	-3%	1%	-3%	1%	-2%	-1%	-3%	-3%	-3%	-3%
1	1%	-2%	1%	-1%	0%	0%	-1%	1%	2%	3%
2	-3%	-2%	-1%	0%	-1%	-1%	-3%	0%	0%	-3%
3	-3%	-2%	-4%	-4%	-6%	0%	-1%	1%	1%	0%
4	-2%	-3%	0%	-2%	-3%	2%	-2%	-6%	-3%	-2%
5	-5%	-1%	-3%	-1%	-4%	2%	-3%	-2%	0%	-2%
6	-3%	-1%	-3%	1%	-5%	-1%	-4%	-4%	-2%	-2%
7	0%	-1%	2%	2%	0%	1%	1%	-1%	-2%	-3%
8	3%	0%	0%	-1%	2%	0%	3%	5%	0%	0%
9	1%	-1%	0%	2%	1%	0%	-1%	-2%	2%	0%
10	3%	-1%	0%	0%	-2%	1%	-1%	-1%	0%	-1%

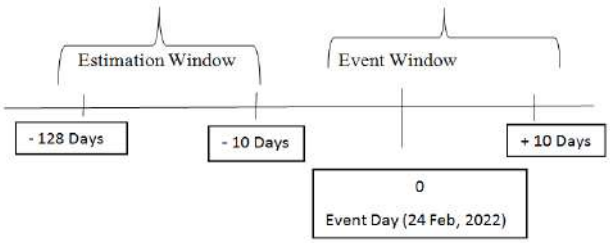

Figure 1: Timeline for the event study

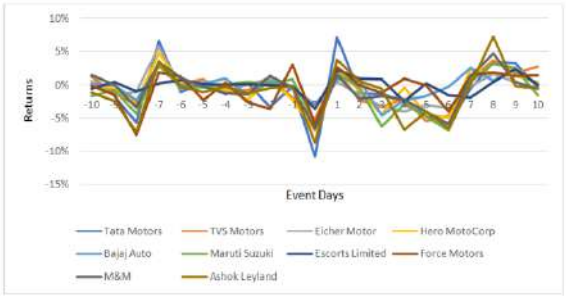

Figure 2:Companies Actual Returns During Event Window (-10, 10)

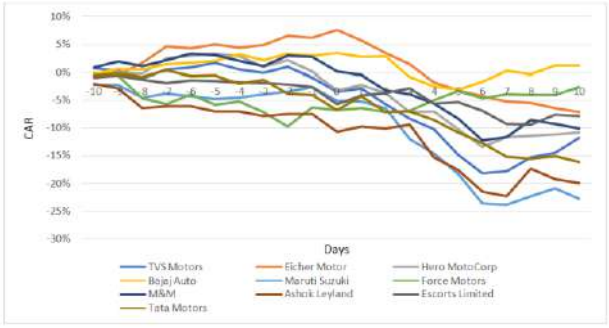

Figure 3: cumulative abnormal returns for each sector during the event window(-10, 10)

RESEARCH ARTICLE

Study of the Branching Pattern of Left Main Coronary Artery in Angiogram Images

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ABSTRACT

Left main coronary artery is one of the branches of the aorta that supplies the major portion of the left side of the heart through its branches. The variations in the branching pattern of the Left main coronary artery are of medical importance in atherosclerotic coronary heart disease, a precursor of sudden myocardial infarction and mortality. Hence it is vital to study its variations. To study the branching pattern of the Left main coronary artery and its variations using angiogram images. 209 angiogram images of individuals were retrospectively studied after obtaining consent. The study included both the sex with age intervals of 22 – 81 years. The incidence of the branching pattern of the Left main coronary artery was observed and its variations were recorded. Results were tabulated and studied with appropriate statistical analysis. The type of branching pattern of the Left main coronary artery was observed to be Bifurcation in 78.95 %,Trifurcation in 15.31 %. The left main coronary artery was absent in 5.74%. Incidence of 78.95 % of bifurcation and 15.31 % of trifurcation pattern of branching of the left main coronary artery was noted in angiogram images. Bifurcation type of branching was the commonest pattern observed in the present study.

Keywords: Left main artery coronary artery, Branching of left Coronary artery, Left anterior descending artery, Ramus intermedius artery, Ramus diagonalis, Left circumflex artery.

INTRODUCTION

The left coronary artery supplies a larger part of the myocardium of the left atrium, left ventricle, and most of the interventricular septum of the heart. It is larger in caliber than the right coronary artery. It arises from the left posterior aortic sinus, runs forwards and to the left, and emerges between the pulmonary artery and left auricle at the atrioventricular groove where it usually divides into the anterior interventricular artery and left circumflex artery [1] Sometimes it gives a third branch the ramus intermedius or the ramus diagonal artery, which typically supplies the lateral and inferior walls acting as a diagonal or obtuse marginal branch when the arteries that usually supply it are absent[2].Variations in the pattern of branching of the left main coronary artery like Bifurcation, Trifurcation, Quadrifurcation, and Pentafurcation have been reported in the literatures[3,4]. Apsara [3] reported 80% bifurcation and 19% trifurcation in angiographic study in Keralite population. Ajayi[4] reported 80.4%,18.5%, and 0.7% of bifurcation, trifurcation, and quadrifurcation branching patterns of the left coronary artery in the South African population. Literature reports that the presence of the third artery the ramus intermedius branch increases the risk of atherosclerosis in the left main coronary artery and its proximity by exerting altered hemodynamics and formation of plaque-causing coronary artery block [5]. Quadrifurcation type of branching pattern in human cadaveric specimens of 4% was reported by Jaishree [6]. The presence of a blocked ramus intermedius branch increases the difficulty in cannulating the artery during a coronary angiogram and surgical interventions [7]. Some authors also view that the presence of a ramus intermedius branch will be associated with more proximal lesions in an anterior descending artery leading to larger areas of myocardial infarctions[8]. These clinical implications motivated us to study the branching pattern of the left coronary artery in the south Indian population.

Aim & Objectives of the study:

i)To estimate the incidence of the type of branching pattern of the left coronary artery.

ii)To study the incidence of ramus intermedius artery in this population.

MATERIALS AND METHODS

The study was retrospectively done using coronary angiogram images of 209 patients who underwent screening coronary angiogram for the risk factors of coronary heart disease in AVM hospital, Salem, after obtaining informed consent and Institutional ethical clearance. The present study was an integral part of the Ph.D. thesis. The study included coronary angiogram images of 128 males and 81females of the age interval 22 – 81 years who underwent treatment for risk factors for cardiovascular diseases like diabetes mellitus, hypertension, and lipid disorders. Coronary angiogram images of blocked coronary arteries, transgender population, and those who underwent coronary artery bypass grafting were excluded from the study. The branching of the Left main coronary artery [1] and its variations was studied. Results were tabulated and studied with appropriate statistical analysis.

RESULTS

The left main coronary artery originated from the left posterior aortic sinus and branched into the anterior descending and left circumflex artery (Fig no:1) in 78.95 % (165 out of 209 individuals) tabulated in Table no:1. In 15.31 % (32 out of 209 individuals) trifurcation type of branching of the left coronary artery was recorded. The incidence of ramus intermedius was 15.31% (Fig no:2). In 5.74 % (8 out of 209 individuals) left main coronary artery was absent.(Fig no:3) and anterior and left circumflex arteries originated directly from the left posterior aortic sinus. Quadrifurcation and Pentafurcation type of branching pattern of the left main coronary artery was not observed in the present study.

DISCUSSION

The branching pattern of the left coronary artery is based on Bapista [9]. Lujinovic [10] is classified as Bifurcation, Trifurcation, Quadrifurcation, and Pentafurcation of which the later is quite rare in incidence. The commonly observed type of branching was the bifurcation of the left main coronary artery into the anterior descending artery and left circumflex coronary artery andin the present study, the incidence was 78.95% which coincided with the findings of the literature[3,4] (Table no: 2).Most of the literature [3,4,10,11,12] (Table no:2) report that bifurcation is the most common type of branching, which also is similar to the findings of our study. Trifurcation of the left coronary artery results in the division of the artery into an anterior descending artery, ramus intermedius or ramus diagonal, and left circumflex artery.In the present study, trifurcation pattern was seen in 15.31 % which is similar to the finding[3,4].The ramus intermedius is also known as Ramus diagonals, Median artery, Ramus lateralis, Marginal ramus, and Intermediate artery[7]. The ramus intermedius or ramus diagonals plays an important role in establishing the collateral circulation during coronary insufficiency by anastomosing with branches of the left anterior descending artery and left circumflex artery[10]. Lujinovic[10] also states that bifurcation type results in a magisterial type of blood supply. As the number of branching patterns increases, like the quadrifurcation, and pentafurcation pattern, blood flow is diffuse in type, which becomes critical during acute coronary insufficiency. The left coronary artery may have four and above terminal branches, and the blood flow in these branches will be reduced compared to the blood flow in the ramus intermedius branch. In the Quadrifurcation [11,12] type of branchingthe ramus diagonal arteries were reported to be two in number. In the present study, the typical quadrifurcation pattern at the termination of the left main coronary artery was not seen but left ventricular branches from the anterior descending artery running diagonally to the apex of the heart were observed. Suggestions of inclusion of the ventricular branches under quadrifurcation pattern by the broader approach were suggested in earlier literature[12]. The pentafurcation type of branching was also not observed in the present study, as it was rarely seen and quoted in kinds of literature [3,4,7,9,10,11,12]. In 5.74 % the left main coronary artery was absent and hence the branching pattern was not seen. The anterior descending and left circumflex arteries originated directly from the aortic sinus. The branching pattern of the left coronary artery plays a vital role as it supplies the major portion of the myocardium of the heart. As per literature [10], the branching pattern of the Left coronary artery differs in its pattern and it plays a vital role in maintaining collateral circulation through its anastomosis with the neighbouring arteries during coronary insufficiency. Regular consistent exercise improves the collateral circulation in stable coronary artery disease [13].

CONCLUSION

Bifurcation pattern was the most consistent and common type of branching pattern of the left coronary artery in the present study population. These variations of the branching pattern confirm the existing knowledge which is vital for the interpretation of coronary angiograms and to the surgeons performing coronary arteries interventional procedures like difficult coronary arterial cannulation, coronary artery revascularization, coronary artery angioplasty, and coronary pass grafting.

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Table no: 1 Incidence of the branching pattern of the Left main coronary artery

Type of Branching pattern of Left Main coronary artery	Males (n=128)	Incidence % Males	Females (n=81)	Incidence % Females	Total %
Bifurcation	97	46.41	68	32.53	78.95
Trifurcation	23	11.004	9	4.306	15.31
Absence of Left main coronary artery	8	3.82	4	1.91	5.74
Quadrifurcation	-	-	-	-	-
Pentafurcation	-	-	-	-	-

Table no: 2 Comparison of Incidences of the branching pattern of Left main coronary artery

Author, Year of Study, Sample size, Method, Population.	Absence of LMCA %	Single branch %	Bi – furcation%	Tri - furcation %	Quadri - furcation %	Penta-furcation %
Baptista[9] (1991) n=150 Dissection	-	-	54.7	38.7	6.7	-
Lujinovic et al [10] (2005) Angiogram n=100& Dissectionn=20 Sarjevo	-	-	65	35	-	-
Apsara [3] (2013) n=100	-	-	80	19	-	-

Angiogram South Indian						
Ajayi [4] (2013) n=151 Angiogram South African	-	-	80.8	18.5	0.7	-
Gaurav[12] (2015) n=100 Dissection North Indian			66	30	4	
Laksmi Prabha[11] (2018) n=55 Dissection South Indian	-	-	54.54	41.82	1.82	1.82
Jaishree [7] (2021) n=76 Dissection South Indian	-	-	-	-	4	-
Present study (2022) Angiogram n=209 South Indian	5.74	-	78.95	15.31	-	-

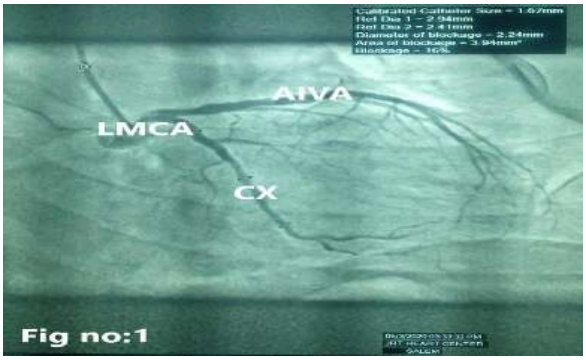

Fig. 1. Bifurcation pattern of branching of Left main coronary artery Legends:
LMCA-Left main coronary artery
AIVA-Anterior interventricular artery
C X-Circumflex artery

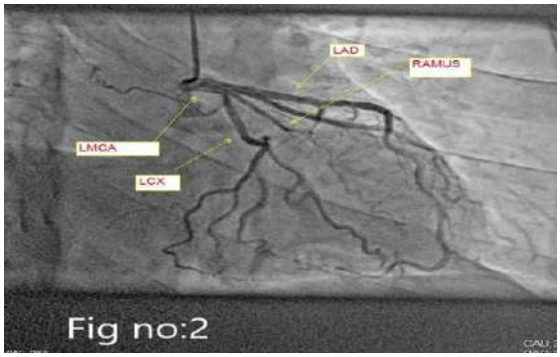

Fig. 2. Trifurcation pattern of branching of Left main coronary artery Legend:
LMCA-Left main coronary artery
LAD -Anterior interventricular artery/Left anterior descending artery
C X-Circumflex artery
Ramus- Ramus Intermedius artery

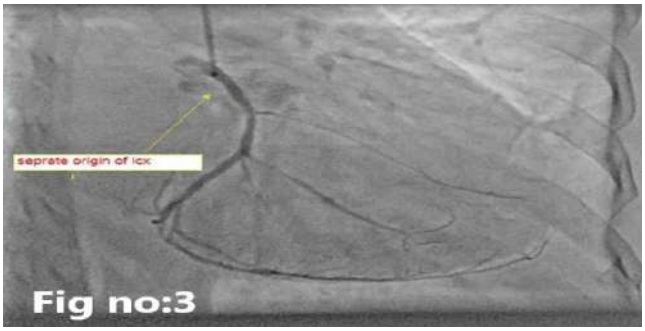

Fig. 3. Absence of branching of Left main coronary artery Legend
LC X-Circumflex artery arising directly from the aortic sinus

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RESEARCH ARTICLE

Effectiveness of Awareness Programme on Knowledge Regarding Water Borne Disease and Its Prevention among General Public Selected Rural Area Kanpur, U.P

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ABSTRACT

In developing countries, drinking water plays a major source for development of microbial pathogens. Around, over 2 million death and 4 billion cases of diarrheal diseases are due to this water borne pathogens. Also, more than 9 out of 10 deaths are occurs in children. The present study was organized with the aim to assess knowledge level, effectiveness of awareness programme on prevention of water borne disease among general public and to associate the pre-test level of knowledge with selected demographic variable. In this study, a quantitative evaluatory approach with A pre experimental research design with one group pre-test and post-test design was used. The population from20-55years of age were sort out by purposive sample technique with the sample sizeas75. The setting of the study was Kukradev village Kanpur, the in strument used to collect the data were consists of demographic Performa and structured interview schedule regarding water-borne disease. The study result reveals that in the pre-test 76% of General public had poor knowledge, 24% of General public had average knowledge and none of the General public had good knowledge in post-test, 30.6% of general public had good knowledge and 52% of general public had average knowledge whereas 17.3% had poor knowledge regarding prevention of water borne diseases. Hence, the study wraps up with the result as a ware nessprogram was successful in improving the knowledge level regarding water borne disease among general middle age group.

Keywords: Assess, Effectiveness, Awareness, Knowledge, General Public, Rural Area.

INTRODUCTION

World Health Organization tells that Health may be a state of physical, psychological, non secular and communal well-being within which absence of any sickness or infirmity[1]. a spread of definitions has been used for various functions reimbursed. Health will be promoted by enhancing pursuits, by doing exercises, having healthy diet and conjointly by reducing some unhealthy activities like regular workout, and by lessen or keep away from unhealthful activities or things, like smoking or uncontrolled stress. Still different factors square measure on the far side each individual and cluster selections like genetic disorders.[2] A sickness may be a explicit abnormalcy that negatively affects structure or perform of all or a part of associate organism, which is thanks to any immediate external injury sickness square measure usually illustrious to be medical conditions that square measure related to specific signs and symptoms. In humans, sickness is commonly used a lot of broadly speaking to check with any condition that causes pain. pathology, distress, social issues or death.[3]

Disease will be conjointly classified in different ways that like communicable versus non-communicable diseases. in step with "WHO" over thirteen million individuals die every year from infectious and parasitic diseases: one in 2 deaths in some developing countries. Poor individuals, women, children, and also the older square measure most vulnerable.[4] Lack of safe water creates a huge burden within the variety of water borne diseases like a diarrhoeic diseases, infectious disease and enteric fever.[5] Many water sources in developing countries square measure unhealthy as a result of they contain harmful physical. Chemical and biological agents. Most of the mortality and morbidity related to water connected grapheme in developing countries is thanks to infectious agents. The four main routes by that water connected infections square measure transmitted square measure water born route, water based mostly route and bug vector route.[6,7] Water born infectious diseases square measure those within which the pathogens, or errhine organism, is gift in water and eaten once the water is consumed. These diseases square measure caused by potable contaminated by excretory product of animal or of human that contain infective pathogenic organism. Most of the pathogens concerned square measure derived from human excretory product, and also the sickness transmitted by consumption of focally contaminated water square measure known as fecal-oral sickness all of the feco-oral diseases can even be transmitted through media apart from water. This water borne diseases will be unfold whereas bathing, washing, potable, or by ingestion exposed to contaminated water.[8,9] In Republic of India pollution is changing into significant issue.[10]

Need for the Study

Unsafe or contaminated water provides improper hygiene inflated the channeling of water borne diseases like diarrhetic diseases, trachoma, infectious disease and Indian cholera though a lot of individuals have access to save lots of water and improve sanitation. Worldwide comparison states that over a billion of people have not access to clean water and.[11] Millions of the youngsters die per annum from water borne diseases and drought frequently afflicts a number of the world's poorest countries we want to extend water potency, particularly in agriculture we want to free ladies and women from the daily task of shipping water typically over nice distances, we have a tendency to should involve them in higher cognitive process on water management we want to create sanitation a priority, around 1.8million individuals die per annum from diarrhetic illness (including cholera), ninetieth area unit kids underneath five. Mostly in developing countries half a mile of diarrhetic illness is attributed to unclean installation, thanks to inadequate installation. Some 6000children die a day from illness related to lack of access safe drinking water-equivalent to twenty large jets unmitigated everyday.[12]

Statement of the Problem:-

A study to assess the effectiveness of awareness programme on knowledge regarding water borne disease and its prevention among General public in selected rural area Kanpur.

Objectives:-

- To assess the knowledge level on water borne disease and prevention among general public in selected rural area.

- To assess the effectiveness awareness programme regarding prevention of water borne disease among general public.
- To associate the pre-test knowledge level with the demographic variable of general public.

METHODOLOGY

Research Approach
Evaluatory Research Approach was used.

Research Design
Pre Experimental One group pretest-posttest design was used in this study.

Variable
Independent Variable
A ware ness programme regarding of health education and demonstration on water borne disease.

Dependent Variable
Knowledge on prevention of water borne disease is research variable.

Demographic Variable
The characteristics and attribute of the study subjects are considered demographic. Age, religion education status type of family type of house, habit and income of homemakers.

Accessible Population
General public in kukradev Mandhana, Kanpur who fulfilled the inclusion and exclusion criteria are accessible population in this study.

Sample
The sample of research study consists of General public in kukradev Mandhana, Kanpur U.P those who were fulfilled the sampling criteria.

Sample Size
In this research, 75 general public from kukradev (Rural area) Mandhana, Kanpur were selected.

Sampling Technique
A Purposive Sampling technique was used to sort out the sample.

The tool consist two Sections
Section A
Age, Religion, education status type of family, type of house, habit and income of home makers.

Section B
Consist of 25 self-structured closed ended questionnaire related to knowledge about water borne disease and it's prevention among general public in rural are a Kukradev, Mandhana.

RESULTS

This chapter also represent the finding of the sample which are preserved in these tables

Section A

Knowledge Score regarding water borne disease in pretest and post test

(Table No. 2 Fig No.1)Reveals that in the pre-test 76% of General public having poor level of knowledge,24% of General public having average level of knowledge and 0% of the General public having good level of knowledge in post-test,30.6% of general public having good level of knowledge and 52% of general public having average level of knowledge whereas 17.3% having poor level of knowledge regarding prevention of water borne diseases.

(TableNo.3)The overall mean knowledge score of general public on water borne disease in pre test mean and standard deviation were 8.25 and 2.6 respectively, In post test, 15.69mean, and standard deviation 4.64. overall knowledge score of General public on Water borne diseases was found to be Inadequate.

Section B

Table no. 4, reveals that the post test knowledge score mean is 15.69 was excess than the pre test knowledge mean score 8.25.The 't' value 13.77 which is more than the table value of 2.08 at 0.05 level of significance. It shows that the awareness programme was effective in increasing knowledge.

Section C Association of pre-test knowledge score with selected demographic variables

It was clearly mention that no significant association was seen between the pre-test knowledge score with the demographic variables of general public such as age, gender, religion, education, type of the house, type of the family, family income, source of water supply, programme attended on prevention of water borne diseases.

Implication of the study

Nursing Practice

- The nurse can be resourceful person for the general public and they canal so teach them to set-forth knowledge regarding prevention of water borne diseases.
- Health education regarding significance of water purification should be provided to the General public with demonstration.
- Instructing and educating the General public to practice good sanitation measures and proper washing techniques of hand.

Nursing Education

- To come up with knowledge, the nursing personnel preferred to be prepared with adequate knowledge and prepares to perform mass health education regarding the prevention of water borne diseases.
- The modules of nursing requires to be nourished with and incorporate with increased content regarding diseases arise due to impure water and unhygienic practices.
- Thestudyalsohighlightstheparticularrequirementsforpreparingthematerials to provide health education to the student nurses those who engaged in services to community area.

Nursing Administration

- Nursing at the various levels of National, State, District, Institutional and local level should pinpoint their curiosity on creating awareness among the public to improve the high quality water, maintaining of personal hygiene and preventive services among the General public.
- Nurse Administrator can conduct awareness programme in schools and also in community areas to impart knowledge regarding prevention of water borne diseases.
- Nurse administrator provides suitable suggestions on displaying posters and pictures regarding water sanitation and prevention methods of water borne diseases to the superiors and can implement it.

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Table No.1:**Representing scoring system of knowledge score regarding water Borne Disease**

Sl. No.	Knowledge score range	Category
1	18-25	Good Knowledge
2	10-18	Average Knowledge
3	1-10	Poor Knowledge

Table no 2: Percentage and frequency distribution of knowledge score regarding water borne disease.

N = 75

	Pre-test		**Post-test**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Poor	57	76%	13	17.3%
Average	18	24%	39	52%
Good	0	0%	23	30.6%
Total	**75**	**100%**	**75**	**100%**

Table No. 3 :-Mean &Standard Deviation according to their knowledge score

	Pre Test	Post Test
Mean	8.25	15.69

Standard Deviation	2.6	4.64

Table - 4 Effectiveness of Awareness programme on Knowledge regarding

n= 75

Knowledge scores	Mean	't' value	p value
Pre test	8.25		
Post test	15.69	13.77	.00000

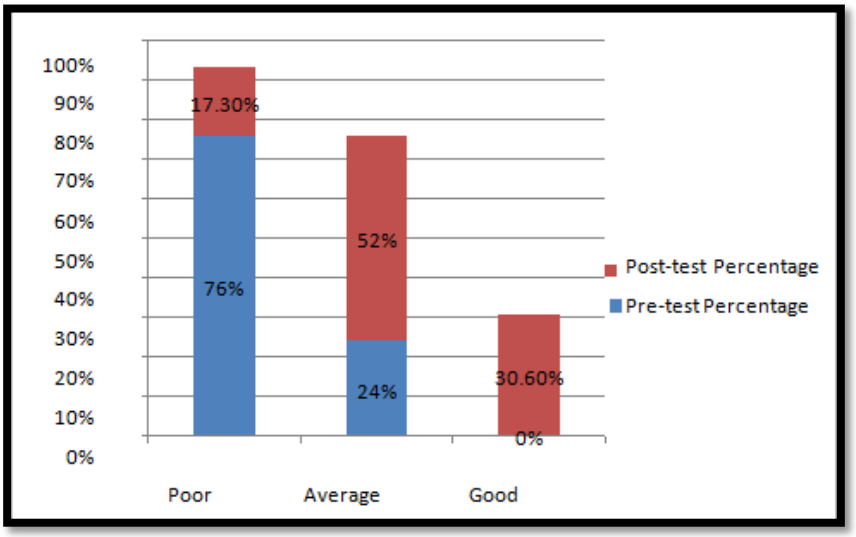

Figure. 1 Bar graph showing the difference between pre-test and post-test knowledge score

RESEARCH ARTICLE

Complexity and Ambiguity, Dealing with Smartphone Purchase Decision during Pandemic

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ABSTRACT

Because of mobility restriction, confinement to houses and all business mostly being done online during extended lockdowns, it has a direct dependence on use of smartphone and similar electronic gadgets. Education, both at colleges as well as high schools was also conducted online and studentshad convenience and compulsion of using smartphones for this purpose. Sales of smartphones, mostly through online purchase increased substantially. In quarter 2- 2020, the online channel's share of the Indian smartphone market rose to 43%. Smartphone demand witnessed a sharp rise during pandemic. Although, a few consumers preferred the touch and feel of the product at the time of buying the smartphone purchase, there was no such choice, but of compulsion of purchasing from online channels only. Retail market had a chaotic and complex business environment of addressing the issues of those buyers, who had difficulty in paying online. Against this background, the present paper aims to study the complexities related to consumer behaviour with respect to smartphone purchases in Odisha, during such business environment. The factors influencing the online smartphone purchase like accessibility, availability, frequency of purchase, convenience, importance of reviews, urgency of purchase and exchange facilities were regressed against the overall shopping experience and the channel switching behaviour for next smartphone purchase in this study. This study should help us to understand the change in behaviour and adoptability of customer with regards to online smartphone purchase. It gives an insight to the retailers

and marketers to evaluate the resilience of online channels. This paper suggests the conceptual model on online shopping behaviour, under forced choice environment.

Keywords: Covid-19 pandemic, smartphone retailing, online channel, consumer buying behaviour

INTRODUCTION

During the last few years in India, the number of smartphone user has grown by leaps and bounds. According to the recent study, there are 844.84 million smartphone users in India[1]. It has also been projected to reach around 931.3 million in the year 2022 with the smartphone penetration[1]. Smartphone has become an essential for almost all people (Watkins *et al.*, 2012)[2]. In India smartphone market is estimated to be INR 2 trillion, which is eye catching for the smartphone brand across the world [3]. The covid – 19 pandemics boosted up the smartphone usage. The report says the penetration of smart phones has doubled from the year 2018 to 2021, i.e. from 29.6 % to 63.7% and during this year at least 27.9 % of households purchased a new smartphone for their children because of onlineeducation [4]. A report says the sales of smartphones met a high growth (26%) during the 1st quarter of 2021 due to improvement in consumer outlook, sustained learning and working from home [5]. But because of covid – 19, now lockdown has become a new normal, that's why the smartphone makers are now more dependent on the online channels than ever before. The fear of infection and social distancing norms acted as promotors to contact-less shopping behaviour [6]. Before the pandemic the online smartphone sales share to its total sales was 42% in 2018 and 37% in 2019. Based on the recent data the share has increased to 48 % during last year i.e. 2020 (*Smartphone Sales See Growth Online - The Financial Express*, n.d.)[7]. So, this study focused on identifying thefactors that influence the consumer to shift towards the online retail channel. It has been observed by the researchers that different retail channels have different shopping motivational values [8]. Many marketing research scholars and some practitioners are trying to understand the motivational values and buying behaviour related to this [9,10] As less availability of literature in this area, this paper will be an exploratory study to identify the uncertainties and difficulties faced by consumers at the time of smartphone purchase during the extended lockdownin Odisha.

REVIEW OF LITERATURE

Uncertainty

During the time of pandemic under the influence of lockdown, people witness uncertainties [11]. Consumers tend to avoid risk due to unpredictability and ambiguity [12]. Smartphone had become an absolute necessity in every household because of its invariable requirement in academic and professional routines. Since, there was uncertainty prevailing with respect to the longevity of the lockdown and things going back to its normal state, smartphone buying behaviour shifted from being a planned behaviour to an impulse buying behaviour which is complex in nature [13]. The pandemic has pushed forward the mobile phone usage, which otherwise would have taken 2-3 years [14].

Change of dynamics in retail:

During the nationwide lockdown a shift in the choice of destination of purchase was observed [15]. This change has been witnessed across several product categories. Some researchers argue that the shift to online channels is a long-term phenomenon owing to the rise in awareness towards the dangers of physical service interactions [14]. With the outbreak of COVID-19, policy makers acrossthe country declared lockdowns and imposed social distancing [16]. Due to closure of offline retailchannels, consumers were compelled to take the online route as there were no options left duringlockdowns [17].

Perceived positive characteristics of online retail channel

Convenience is considered as one of the most important factors for persuading online purchase due to 24*7 availability and doorstep delivery services [18,19] . Shoppers generally prefer online retail channels at times when they want to save time and effort [20]. It is more advantageous to get product data online contrasted with offline stores and it helps online customers with staying away from salespersons and bother of shopping in crowded markets [21] . Online shopping also enables consumers to compare products with respect to cost analysis, product features and description [22,23,24]. The range of products available online gives internet retailers an advantage over their brick-and- mortar competitors [25] as customers have more options to pick from because of the larger variety. People's purchase behaviour and intentions, as well as their attitudes toward products and retailers,are influenced by consumer ratings and reviews. Customers frequently rely on product ratings and reviews to mitigate the risks associated with online purchasing [26]. The return policies also allowcustomers the ability to experience the product, assess whether it meets their needs, and if necessary, return the product [27] .

Perceived negative characteristics of online retail channels

The internet and traditional shopping both have their own advantages and disadvantages. Online shopping doesn't require traveling long distances, offers more variety, remains functional 24*7, offers huge discounts and extend the facility of customer reviews. On the other hand, traditional shopping allows customers to physically examine the products which otherwise online shopping lacks [25]. This physical verification was not possible during covid pandemic [28]. Customer service,in terms of interpersonal and information support at the point of purchase, is critical in retail formatselection, particularly [29] for technically sophisticated devices like smartphones. After-sales service is a deciding element in the retail channel choice [30] when purchasing a smartphone. Consumers are discouraged from shopping online because of issues [31] with post-purchase services. Consumers felt secure shopping for devices like smartphones in retail outlets, as per choice [29].This pandemic condition posed a challenge to the global education system, forcing educators to switch to an online mode of teaching overnight, compelling them to purchase a smartphone. COVID-19, while making the smartphone a necessity, also pushed many offline consumers to online platforms because of restrictions on movement. According to a survey, more than half of all cell phones sold in India in 2021 will be purchased online, compared to more than a third last year [32].

RESEARCH OBJECTIVE

- To identify and access the motivational factors that influence the purchase of smartphoneduring pandemic.
- To identify complexities dealing with smartphone purchase decision with regards to retail format choice (brick and mortar store) during the extended lockdown and shutdown.

METHODOLOGY

The study instrument was designed by identifying variables from contemporary literature pertaining to online purchase behaviour and taking into consideration the new pandemic paradigm shopping habits with respect to smartphone purchase. The instrument had altogether 24 items which were divided into 3 sections. The first section comprised of 6 socio-demographics related items, followed by second section which had 13 shopping motivation factors along with one itemto measure the level of satisfaction from the last smartphone purchase experience which is the dependent variable of the study. The scale for the motivational factors was designed on 5-point Likert scale where the respondents were asked to rate the importance of the factor during their smartphone purchase on a scale ranging from strongly disagree = 1 to strongly agree = 5. The scalefor the dependent variable was a 5-point Likert scale ranging from extremely unsatisfied = 1 to extremely satisfied = 5. The next section contained 6 items relating to information regarding theirlast smartphone purchase and their preferred channel for next smartphone purchase. The instrument was validated by academic experts for face validity before collecting data from respondents. Pilot study was done with 50 responses before final data collection. The respondents were asked to participate only if they belong to the state of Odisha and had purchased a smartphone online within last one year. Non-probability sampling with a convenience sampling technique has been adopted. Collection of data was done through both online and

physical form mode. The study instrument was presented in both English and Odia language to eliminate the language barrier among semi-urban and rural respondents. The final sample consisted of 343 responses from 28 districts of Odisha making it a representative sample for analysis. The collected data was then subjected to analysis.

DATA ANALYSIS

The analysis of demographics (Table 1) of the respondents shows that 41.40% are female and 58.60% are male. Most of the respondents lie in the age bracket of 26-35 i.e., 135 (39.36%), followed by age group 14-25 i.e., 110 (32.07%). 36-50 and more than 50 years respondents are 68 (19.83%) and 30 (8.75%) respectively. Educational qualification wise most of the respondents are graduate i.e., 146 (42.57%), followed by 133 (38.78%) post-graduate, 45 (13.12%) undergraduate and 19 (5.54%) doctorates. Moreover, concerning the occupation 81 (23.62%) are student, 31 (9.04%) are home makers, 29 (8.45%) are self-employed, 133 (38.78%) are private sector job holders, 60 (17.49%) are public sector job holders, 7 (2.04%) are retired and 2 (0.58%) are unemployed. The annual family income depicts: 113 (32.94%) respondents have an annual family income between 5 to 10 lakhs, followed by 87 (25.36%) respondents with less than 2 lakhs, 72 (20.99%) respondents between 2 to 5 lakhs and lastly 71 (20.70%) respondents with more than 10 lakhs of annual family income. Out of the 343 respondents, approximately 65% (224) respondents purchased the smartphone for their own use, whereas rest 35% (119) respondents purchased it for others which include family members, relatives, friends and colleagues. Moreover, 84 (24.49%) respondents have purchased more than one smartphone in the last one year, while 259 (75.51%) respondents have purchased at least one smartphone. Inferential statistics i.e., multiple linear regression analysis was used to test the significance of the predictors on the level of satisfaction based on the experience of the last smartphone purchase from online retail platforms during pandemic. The regression was done at 95% confidence interval. The resulting model summary is presented in table 2. The above table suggests that 53.4% variation in satisfaction level of the shopping experience can be predicted by 13 predictors chosen for the study. The model is statistically significant with an F-value of 31.112, as presented in table 3.

The summary of coefficients presented (Table 4) shows that all the predictors significantly contribute to the model except price of the smartphone, salesperson assistance, ease of payment and online reviews while buying a smartphone. Among the predictors which are significant, availability of different models ($\beta = 0.226$, $t = 4.831$, $p = 0.000$), exchange and return facility ($\beta = 0.191$, $t = 3.926$, $p = 0.000$), convenience ($\beta = 0.101$, $t = 2.072$, $p = 0.039$) and accessibility to point of purchase ($\beta = 0.226$, $t = 4.831$, $p = 0.000$) are positively correlated to satisfaction level of the last smartphone shopping experience from online retail platforms. On the contrary, predictors like need for touch and feel ($\beta = -0.129$, $t = -3.294$, $p = 0.001$), after-sales service ($\beta = -0.112$, $t = -2.607$, $p = 0.010$), trust & reliability of the retail channel ($\beta = -0.124$, $t = -3.301$, $p = 0.001$), urgency of purchase ($\beta = -0.076$, $t = -2.306$, $p = 0.022$) and ease of product comparison ($\beta = -0.175$, $t = -3.088$, $p = 0.002$) are negatively correlated to the level of satisfaction pertaining to shopping experience of online smartphone purchase. Further analysis using chi-square independence test (Table 5) revealed an association between respondents' annual family income and the price of the smartphone they have purchased [$\chi 2(9) = 53.794$, $p = 0.000$]. Persons with higher family income are more likely to purchase expensive phones. A one-way analysis of variance was conducted to evaluate the preferred retail channel for next smartphone purchase based of the level of satisfaction of last online smartphone purchase ($n = 343$). The independent variable, preferred retail channel for next smartphone purchase, included three groups: online ($M = 4.43$, $SD = 0.756$, $n = 210$), retail store ($M = 3.98$, $SD = 1.182$, $n = 59$) and "can't say now" ($M = 3.74$, $SD = 1.355$, $n = 74$). The ANOVA was found to be significant $F(2, 340) = 15.052$, $p = 0.000$, which concludes that there is a significant difference in respondents' level of satisfaction based on their preferred retail channel for next smartphone purchase. A post hoc comparisons to evaluate the pairwise differences among the group means were conducted as shown in (Table 6). The test revealed a significant pairwise difference between the mean satisfaction score of respondents who would prefer online, retail store and "can't say now" for their next smartphone purchase, $p < 0.05$. However, respondents who would prefer retail store for their next purchase don't significantly differ from respondent's who can't decide upon their next purchase channel. Lastly, when respondents were asked whether they would have still purchased their smartphone online given the market condition were normal and there was no pandemic or lockdowns prevailing, 218 (63.56%) responded affirmatively whereas 58 (16.91%) of respondent indicated that they would have bought it offline from a brick-and-mortar store and 67 (19.3%) may or may not have opted for online retail options.

DISCUSSION AND CONCLUSION

The study attempted to identify and access the motivating variables that influence smartphone purchases during a pandemic, as well as the complexity associated with smartphone purchase decisions in terms of retail format (brick and mortar shop) during the extended lockdown and shutdown. Multiple linear regression analysis was done to examine the relevance of the predictors on the level of satisfaction based on the latest smartphone purchase from online retail platforms during the pandemic using inferential statistics. Except for the price of the smartphone, salesperson assistance, simplicity of payment, and internet reviews while buying a smartphone, the summary of coefficients demonstrates that all other factors strongly contribute to the model. The availability of a variety of models, the opportunity to exchange and return items, convenience of use, and proximity to the point of purchase were all important factors of satisfaction with the most recent smartphone shopping experience from online retail platforms, according to the study's findings. Predictors like the demand for touch and feel, after-sales service, trust and reliability of the retail channel, and ease of product comparison, on the other hand, are negatively related to satisfaction with the online smartphone purchasing buying experience. The study also revealed the level of satisfaction with the shopping experience of online smartphone purchase is negatively correlated with the urgency of purchase. Based on the amount of satisfaction with the last online smartphone purchase, a one-way analysis of variance was used to determine the preferred retail channel for the next smartphone purchase. The findings revealed that lower satisfaction level from the previous online purchase have statically proved to make respondents switch to offline channel for the next purchase or being indecisive about the next channel for their smartphone purchase. The major findings of the study were availability of numerous models, exchange and return facility, ease, and accessibility to point of purchase are all major determinants of satisfaction with the most recent smartphone shopping experience from online retail platforms. One of the more noteworthy observations was when asked if they would have bought their smartphone online if market conditions were normal and there was no pandemic or lockdowns in place, 218 (63.56%) said yes, while 58 (16.91%) said they would have bought it offline from a brick-and-mortar store and 67 (19.3%) said they might or might not have.

Implication

In several ways, the paper attempts to add valuable insights to marketing theory. The study instrument was created by identifying variables from existing literature with regard to online purchase behaviour while taking into account the new pandemic paradigm shopping habits with respect to smartphone purchase. This study will be exploratory research that will help to identify and understand the motivational factors that influence the purchase of a smartphone during a pandemic, as well as to identify complexities dealing with smartphone purchase platform decisions in Odisha during the extended lockdown and shutdown. Due to the closure of offline retail channels, consumers were forced to shop online because there were no other options available during lockdowns. As a result of the homogeneity in retail market conditions, the study's findings relevant to smartphone purchase can be extrapolated to a larger Indian consumer and, to a limited extent, Asian consumers.

Limitation and Future Research

While this study focused on identifying the factors that influence consumers to shift to the online retail channel during lockdown and shutdown periods, other factors may exist that have yet to be explored. The scope of this study was limited to Odisha's 28 districts. For generalizability, similar studies can be conducted across geographies and other categories. In future studies, other aspects of smartphone shopping behaviour, such as a comparative Analysis of retail format choice behaviour during the Second Wave with the First Wave of covid 19, can be investigated. Finally, similar studies on different product categories, such as consumer preference and buying pattern of medicines, grocery, apparel, and service industry like adoption of internet banking during pandemic can be conducted to contribute to retail format choice behaviour.

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Table 1: Analysis of Demographics

Demographic items (for 343 respondents)	Frequency	(%)
Gender		
Female	142	41.40%
Male	201	58.60%
Age		
14-25	110	32.07%
26-35	135	39.36%
36-50	68	19.83%
>50	30	8.75%
Education		
Undergraduate	45	13.12%
Graduate	146	42.57%
Post – Graduate	133	38.78%
Doctorate	19	5.54%
Occupation		
Unemployed	2	0.58%
Student	81	23.62%
Home Maker	31	9.04%
Self – Employed	29	8.45%

Job Holder (Private Sector)	133	38.78%
Job Holder (Public Sector)	60	17.49%
Retired	7	2.04%
Annual Family Income		
< 2 Lakhs	87	25.36%
2- 5 Lakhs	72	20.99%
5 Lakhs - 10 Lakhs	113	32.94%
> 10 Lakhs	71	20.70%
Source: Authors' estimation		

Table 2: Multiple Linear Regression Analysis

Model	R	R Square	AdjustedR Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.743[a]	0.551	0.534	0.705	0.551	31.112	13	329	0.000

Table 3: Regression model analysis

Model		**Sum ofSquares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	200.890	13	15.453	31.112	.000[b]
	Residual	163.413	329	0.497		
	Total	364.303	342			

Table 4: The summary of coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.067	0.291		10.544	0.000
	Price of the smartphone	0.004	0.040	0.005	0.099	0.921
	Need for Touch and Feel	-0.129	0.039	-0.161	-3.294	0.001
	Salesperson Assistance while buying a smartphone	-0.053	0.039	-0.065	-1.364	0.174
	After-sales service while buying a smartphone	-0.112	0.043	-0.143	-2.607	0.010
	Availability of different Models or Product Variety while buying a smartphone	0.226	0.047	0.234	4.831	0.000
	Trust & Reliability on the channel	-0.124	0.037	-0.139	-3.301	0.001

	Ease of payment options while buying a smartphone	-0.025	0.043	-0.026	-0.578	0.564
	Online reviews whilebuying a smartphone	0.062	0.049	0.066	1.266	0.207
	Exchange and return facility while buying a smartphone	0.191	0.049	0.203	3.926	0.000
	Urgency of purchase	-0.076	0.033	-0.097	-2.306	0.022
	Convenience while buying a smartphone	0.101	0.049	0.100	2.072	0.039
	Ease of product comparison while buying a smartphone	-0.175	0.057	-0.159	-3.088	0.002
	Accessibility of point of purchase while buying a smartphone	0.231	0.044	0.245	5.224	0.000

Table 5: Chi-square independence test

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	53.794[a]	9	0.000
Likelihood Ratio	47.025	9	0.000
Linear-by-Linear Association	30.885	1	0.000
N of Valid Cases	343		

Table 6: ANOVA analysis -Satisfaction level versus preferred channel for next Smartphone purchase

Multiple Comparisons						
Dependent Variable: Last Smartphone Shopping Experience (Satisfaction Level)						
Tukey HSD						
					95% Confidence	
(I) Preferred Channel for nextSmartphone Purchase	(J) Preferred Channel for nextSmartphone Purchase	Mean Difference(I-J)	Std. Error	Sig.	Interval	
					Lower Bound	Upper Bound
Online	Retail Store	.450*	.146	.006	.11	.79
	Can't say now	.690*	.134	.000	.37	1.01
Retail Store	Online	-.450*	.146	.006	-.79	-.11
	Can't say now	.240	.173	.350	-.17	.65
Can't say now	Online	-.690*	.134	.000	-1.01	-.37
	Retail Store	-.240	.173	.350	-.65	.17
*. The mean difference is significant at the 0.05 level.						

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RESEARCH ARTICLE

Factors Influencing Consumers Actual Food Purchase Intention towards Organic Food Products

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ABSTRACT

Organic foods are of high nutritional value, more concerned about health, fresh, tasty, and ecologically friendly than conventional food. Nowadays consumers are shifting over to organic foods and also they are willing to pay high prices. In this study, the researcher finds out the actual buying behaviour. A structured questioner method was used to collect data from 534 consumers, and convenient sampling methods were used to collect data. Various methods, such as Amos and hierarchical multiple regression analysis, were used to analyse the data. In this study, the researcher wants to find out the food purchase intention using four confirmed factors like Brand Consciousness, Price Consciousness, Green Consumption Behaviour, Environment Consciousness, with the help of hierarchical regression analysis, the researcher allows one by one factor to test the most efficient significant factors that areaffecting food intention towards organic products.

Keywords: organic food, Brand Consciousness, Price Consciousness, , Environment Consciousness, Food purchase intention.

INTRODUCTION

Environmental Consciousness

Consumers' behaviour and attitudes towards green may lead to motive environmental and ecological factors. They tend to purchase environment-friendly or harmless products that have a less environmental impact. The researcher suggests that while consuming the product, based on consumer decision often take utmost care about environmental

protection and animal welfare. They are willing to pay a premium charge for organic wines (D'Amico *et al*.,2016**).** These customers also connect with their purchasing decisions towards environmental and ecological systems. Consumers who have an extraordinary level of environmental concern or environmental protection that would impact healthy human life & society. Firms will also care about ethical practice while producing the product, uphold high quality, satisfying consumer needs, and also take about environmental protection. The environmental concern is a moderating variable to find out the trust towards organic food consumption (Sumathy *et al*., 2021). The researcher recognized some variables, like environmental factors, acquiring responsibilities, belief, and pro-environment action. The causal chain moves from values and expectations oriented about the human-environmental relationships, that lead to environmental action. Consumers prefer organic products based on food safety, human health, and environmental impact (Sumathy*et al.,*2018). The study emphasizes consumer understanding and identifying organic food products. The researcher used various measures to determine the perception towards environmental issues (Prakash e*t al.,*2018).This scale that measures identify particular customers' views of environmental issues and their ability to address their buying patterns. Environmental concern in this study refers to just how concerned consumers are about environmental issues. It refers to the psychological factors that affect a consumer's ability to participate in eco-friendly actions.

Brand Consciousness

Consumers are willing to pay a higher premium for a branded, high-quality product. They are preferred to consumes only a well-known brand available in the markets or some of them preferred bestselling brand in the nation. Introducing more international brands by the emerging retail sectors but our Indian consumers are more conscious about the brand. In 2007, India was ranked as the third most brand-conscious country .The brand creates an image in the mind of the consumer which is often associated with quality, contributing to the selection of specific products.

Primarily, the brand name or logo indicates a uniqueness of a particular product. Every day the position of the consumer grows faster and brand management becomes more important to survive in the market (Rubio, *et al.,*2014). Accumulative growth of green label in the organic food marketplace by using an individual to transform or shape implicitand explicit attitudes toward the organic product (Richetinet*al.,* 2016).The researcher investigates the possibility of changes in brand identification, attitude, and behavior. There is a large number of fictitious brands available in the market, consumers can use a Self-Referencing task while they buying their organic foods.The implicit intention is considered as an important factor or nature of developing the intention to shift consumers toward organic food.

Price consciousness

Price consciousness determines a degree of price changes that determines the consumer's purchase beahviour. It is the key vital component for the consumer. The slight changes in the price lead to affect the purchase behavior of the consumer. Consumers believe that premium prices lead to a high-quality commodity and vice versa. Low quality, on the other hand, which is related to a low price. Identified the major factor as price, that determines the consumer to buy organic food. There is still a positive association between price and consumer (Prakash *et al*., (2018) and Hwang and Chung (2019). These customers can assess the quality of organic food and make purchasing decisions based primarily on the cost of organic food products. Since organic food is more expensive than conventional food, price-conscious consumers can consume fewer organic products. Because they believe that conventional foods may have adequate product value. For customers who consider price to be a major factor in their purchase decision, intention towards the purchase of organic food also diminishing. Buyers, on the other hand, are price conscious but may ignore the cost of organic produce. These consumers estimate organic food as a non-price factor-like freshness, taste, high nutritional value, and safer to the environment. The quality of organic food is measured based on consumer's beliefs. These kinds of consumers are ready to pay a high charge for organic foods. Therefore, purchase intention will strongly influence consumption based on perceived organic food quality.

Green consumer consumption

Green consumer behavior explains the association between the green attitude and individual green consumption behavior. Green consumer behavior use of an organic product, made with practices that provide energy-saving, then by the act of reprocessing, green consumer purchase an organic product that may not affect the environment. (do Paco, A., Shiel, C., & Alves, H. 2019)the green advertising causes only less influence on organic buying behaviour. The association between these thoughts becomes significant whenever considering how best to develop organic marketing campaigns and communication tactics able to further the green behaviour encouraged.

MULTIPLE HIERARCHICAL REGRESSION ANALYSIS

In continuation to correlation, relationships between food purchase intention as a dependent variable and dimensions such as brand consciousness, price consciousness, environmental consciousness, and green consumer consumption as predictor variables are computed to determine the power between the two categories.

FRAMED HYPOTHESIS

H_0:There is no significant relationship between i) Brand consciousness ii) Price consciousness iii) Environmental consciousness iv) Green consumer consumption and food purchase intention towards organic products.

There is no significant relationship between

H_0a: Brand consciousness and food purchase intention of consumers buying the organic product.
H_0b: Price consciousness and food purchase intention of consumers buying the organic product.
H_0c: Environmental consciousness and food purchase intention of consumers buying the organic product.
H_0d: Green consumer consumption and food purchase intention of consumers buying an organic product.

To interpret the data and evaluate the hypotheses, the researchers used SPSS and AMOS. To begin, descriptive statistics and correlation coefficients were analysed using SPSS. Multiple regression and hierarchical multiple regression analysis were used in this research. As a final point, to test the moderated mediation effect the SEM model can be used along with bootstrapping method also used.

Table 1 indicates the descriptive statistics(Mean & Standard Deviation) and correlation between variables.The result shows that brand consciousness was found to be strongly associated with the intention to purchase organic foods ($r = 0.372$, $p < 0.01$), Price consciousness was found to be strongly associated with the intention to purchase organic foods ($r = 0.577$, $p < 0.01$), Environmental consciousness was found to be strongly associated with the intention to purchase organic foods ($r = 0.678$, $p < 0.01$). Moreover, Green consumption behaviour was found to be strongly associated with the intention to purchase organic food ($r = 0.610$, $p < 0.01$).

MEASUREMENT MODEL

Above table 2 shows testing the reliability by using Cronbach's alpha.The value of Cronbach's alpha is accepted >0.70 shows that Brand consciousness, price consciousness, environmental consciousness, food purchase intention, and green consumption were 0.913, 0.717, 0.896, 0.946, and 0.960. Consequently,all the variables are reliable and adequate inthis study.

To identified model fit, using AMOS to shown a CFA(Confirmatory Factor Analysis). According to Kline (2015) measuring a goodness of model fit indicates, Chi-square/degree of freedom is less than 3, Goodness of fit index(GFI), Normed fit index(NFI), and Comparative fit index(CFI) is all >0.90, and Root-mean-square error(RMSE)estimate is < 0.08. The results of CFA required to meet all the requirements (χ^2/d.f. = 14.562, GFI = 0.987, NFI = 0.978, CFI = 0.980 and RMSEA = 0.160) .The researcher demonstrates a good model fit in the research model figure (1). Researcher alanysis the data by using hierarchical regression. Chekima, B(2019), Sultan, P(2020), Shamsi (2020) based on their prior organic food literature some communal variables are used to measure the highly influenced on the dependent variable are gender, age,income, marital status, and based on their purchase experience. Testing the hypothesis in

this study by using hierarchical regression analysis. Table.3 shows a set, the predictors accounted for significant intention for consuming organic food , R-square=.541, dF(4,528)=139.863, p<.001.

Table 4 shows a Price consciousness (β=.163, S.E=.051, p=.001), environment consciousness (β=.474, S.E=.058,p=.000)and green consumption consciousness (β=.078, S.E=.015, p=.000),p<.001) were positive significant intention to consumption organic food. Brand consciousness (β=-.005, S.E=.015, p=.727) was negative. It is not a significant predictor for consumption of organic food.

Hierarchical entry of predictors in SPSS, researcher begin by specifying the simplest model in Block I of I by adding our predictor and outcome variables in the independent and dependent boxes. Then click on the 'Statistics' tab and select 'R-squared change'. Although one often selects other options under this tab, keeping it as simple. For this step, entering 'brand consciousness' is the lone predictor. Once this model is specified, we click the 'Next' tab. This leads up to the next Block, researcher enter the next set of the predictor. In 'Block II of II'still, enter the Step 2 predictors at this stage. Here, enter the next predictor, 'Price Consciousness'. Once enter the predictor in Step 2, we click the 'Next' tab to move to the next Block.Here, we are entering the remaining predictors into the model in 'Block III of III'.Then we click the 'OK' tab.

Table 5 shows the result of the model summary, In Model Iis significant for consumption of organic food, R^2=0.138, dF(1,532)=85.491, p=0.000.In Model II, Brand consciousness and Price consciousness is a significant factor for intention to consumption of organic food, R^2=0.212, F(2, 531)=71.255, p=0.000. The change in R^2 from Model I to Model II was 0.074, reflecting significant increases in their variation F(1,531)=49.263, p is less than 0.001.In Model III, the predictors accounted for significant variation in consumption of organic food, R^2=0.511, F(4,529)=140.084, p is less than 0.001. The change in $R^2$from Model II to Model III was 0.302, reflecting a significant increase in explained variation, F(2,529)=164.920, p is less than0.001.

Table 6 The regression slopes and tests for Model 3 are the same as those from the previous simultaneous multiple regression. Regression involving removal of predictors in SPSS. Model I contains the full set of predictors. Model 2 removes brand consciousness. Model 3 removes price consciousness**.** Table 7 shows the set of predictors in Model I, it is clear that all the variables have a significant relationship in purchasing the organic product from model II, R^2 =.514, F(4,529)= 381.111, p<0.001. After removing the brand consciousness from a model I, the predictors in Model II still accounted for significant variation, R^2=0.514, F(3,530)=187.044, p<0.001. The R^2 does not have any changes (0.514) from Model 1 to Model II was not significant, F(1,529)=0.127, p=0.722. This indicates that brand consciousness may not be a substantial contributor to the variation in food purchase intention.

After removing price Consciousness, the predictors in Model III continued to account for significant variation, R^2=0.505, F(2,531)=270.602, p<0.001. The R^2decrease (.009) from Model II to Model III was significant, F(1,530)=10.375, p=.001. This suggests that price consciousness is a potential contributor to organic food purchase intention.

Dependent Variable: Food Purchase Intention

Table 8 indicates to assess multi-collinearity verified the tolerance and VIF. Tolerance must be > 0.02then there is no multi-collinearity problem.VIFmust be <5.0, eigenvalue must not be close to zero, and also verify the conditional index value must be less than 15, there is no multicollinearity problem the variables.

CONCLUSION

The important purpose of this research is to observe the consumers' actual food purchase intention towards organic food. The researcher examines the various factors inducing organic food purchase intention. In preceding studies, consumers' food purchase intention may not be converted into actual buying behaviour. The outcomes of the result

have exposed four factors are brand consciousness, price consciousness, environmental consciousness, green consumption behaviour that influence food purchase intention. As per the result of hierarchical regression analysis allowing or testing one by one factor alone, all the factors like. brand consciousness, price consciousness, environmental consciousness, green consumption behaviour, and availability positively influence purchase intention towards organic food. Researcher finds out a highly influenced factor as prices consciousness to predict food purchase intention towards organic food. The price of a product plays a major part for the consumer to choose a portion of organic food.

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Table: 1. Descriptive Statistics and Correlation Analysis

Factors	Mean	SD	Consumer food purchase intension towards organic foods	
			Correlation [2]	P-Value
Brand Consciousness	22.7453	5.86434	.372	.000
Price Consciousness	9.3065	1.77805	.577	.000
Environmental Consciousness	9.0350	2.23481	.698	.000
Green Consumption Behaviour	31.0916	7.82199	.610	.000

Table 2. Measurement Model: Reliability and Validity

Research Construct		C.R. Value	AVE Value	√ AVE	Cronbach's α	Factor Loading
Brand Consciousness	BCC1	0.881	0.541	0.736	.913	0.761
	BCC2					0.882
	BCC3					0.841
	BCC4					0.784
	BCC5					0.724
	BCC6					-0.139
	BCC7					0.752
Price consciousness	PC1	0.616	0.350	0.592	.717	0.709
	PC2					0.741
	PC3					0.591
Environment consciousness	EC1	0.793	0.562	0.750	.896	0.768
	EC2					0.933
	EC3					0.887
Food purchase intension	FPI1	0.843	0.641	0.801	.946	0.923
	FPI2					0.908
	FPI3					0.942
Green consumption consumer	G1	0.956	0.710	0.843	.960	0.700
	G2					0.867
	G3					0.944
	G4					0.79
	G5					0.884
	G6					0.741
	G7					0.907
	G8					0.874
	G9					0.845

Table: 3 Model and fitness measuring relationship between Brand Consciousness, Price Consciousness, Environment Consciousness, Green Consumption Behaviour and organic food purchase intention towards organic food products.

R	R^2	Adjusted R^2	SE	R Square Change	F Value	DF1	DF2	Sig
.717[a]	.514	.511	1.65083	.514	139.863	4	528	.000

a. **Predictors: (Constant), Green Consumption Behaviour, Price Consciousness, Brand Consciousness, Environment Consciousness**

Table: 4 Coefficients measuring relationship between brand consciousness, price consciousness, environmental consciousness, green consumption behaviour, and organic food purchase intention towards organic food product.

Coefficients[a]							
Variable	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**	**Collinearity Statistics**	
	β	**Std. Error**	*β*			**Tolerance**	VIF
(Constant)	1.506	.453		3.327	.001		
Brand Consciousness	-.005	.015	-.013	-.350	.727	.693	1.444
Price Consciousness	.163	.051	.123	3.202	.001	.627	1.596
Environment Consciousness	.474	.058	.449	8.180	.000	.305	3.279
Green Consumption Behaviour	.078	.015	.259	5.180	.000	.367	2.727

Dependent Variable: Food Purchase Intention

Table 5. Model summary

Model	R	R^2	Adjusted R^2	SE	R Square Change	F Value	DF1	DF2	Sig
1	.372[a]	.138	.137	2.19077	.138	85.491	1	532	.000
2	.460[b]	.212	.209	2.09769	.073	49.263	1	531	.000
3	.717[c]	.514	.511	1.64942	.303	164.920	2	529	.000

a. Predictors: (Constant), Brand Consciousness

B. Predictors: (Constant), Brand Consciousness, Price Consciousness

C.Predictors: (Constant), Brand Consciousness, Price Consciousness, Green Consumption Behaviour, Environment Consciousness

Table. .6 Coefficients

Coefficients[a]							
Variable	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**	**Collinearity Statistics**	
	β	**Std. Error**	*β*			**Tolerance**	VIF
(Constant)	6.213	.380		16.347	.000		
Brand Consciousness	.150	.016	.372	9.246	.000	1.000	1.000
(Constant)	3.599	.521		6.911	.000		
Brand Consciousness	.107	.017	.266	6.419	.000	.866	1.155
Price Consciousness	.385	.055	.291	7.019	.000	.866	1.155
(Constant)	1.506	.452		3.330	.001		
Brand Consciousness	-.005	.015	-.013	-.357	.722	.693	1.444
Price Consciousness	.163	.051	.123	3.207	.001	.627	1.596
Environment Consciousness	.474	.058	.449	8.188	.000	.305	3.279
Green Consumption Behaviour	.078	.015	.259	5.185	.000	.367	2.727

a. Dependent Variable: Food purchase Intention

Table .7 Model Summary

Model	R	R^2	Adjusted R^2	SE	R Square Change	F Value	Mean Square	DF1	DF2	Sig
1	.717[a]	.514	.511	1.64942	.514	140.084	381.111	4	529	.000
2	.717[b]	.514	.512	1.64806	.000	.127	508.032	1	529	.722
3	.710[c]	.505	.503	1.66255	-.010	10.375	747.959	1	530	.001

A. Predictors: (Constant), Green Consumption Behaviour, Price Consciousness, Brand Consciousness, Environment Consciousness

B. Predictors: (Constant), Green Consumption Behaviour, Price Consciousness, Environment Consciousness

C. Predictors: (Constant), Green Consumption Behaviour, Environment Consciousness

Table.8. Coefficients

Coefficients[a]							
Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	β	Std. Error	β			Tolerance	VIF
(Constant)	**1.506**	**.452**		**3.330**	**.001**		
Brand Consciousness	-.005	.015	-.013	-.357	.722	.693	1.444
Price Consciousness	.163	.051	.123	3.207	.001	.627	1.596
Environment Consciousness	.474	.058	.449	8.188	.000	.305	3.279
Green Consumption Behaviour	.078	.015	.259	5.185	.000	.367	2.727
(Constant)	**1.483**	**.447**		**3.316**	**.001**		
Price Consciousness	.158	.049	.119	3.221	.001	.667	1.499
Environment Consciousness	.473	.058	.448	8.187	.000	.306	3.269
Green Consumption Behaviour	.077	.015	.255	5.282	.000	.394	2.538
(Constant)	**2.508**	**.317**		**7.902**	**.000**		
Environment Consciousness	.577	.048	.546	11.923	.000	.444	2.252
Green Consumption Behaviour	.061	.014	.203	4.421	.000	.444	2.252

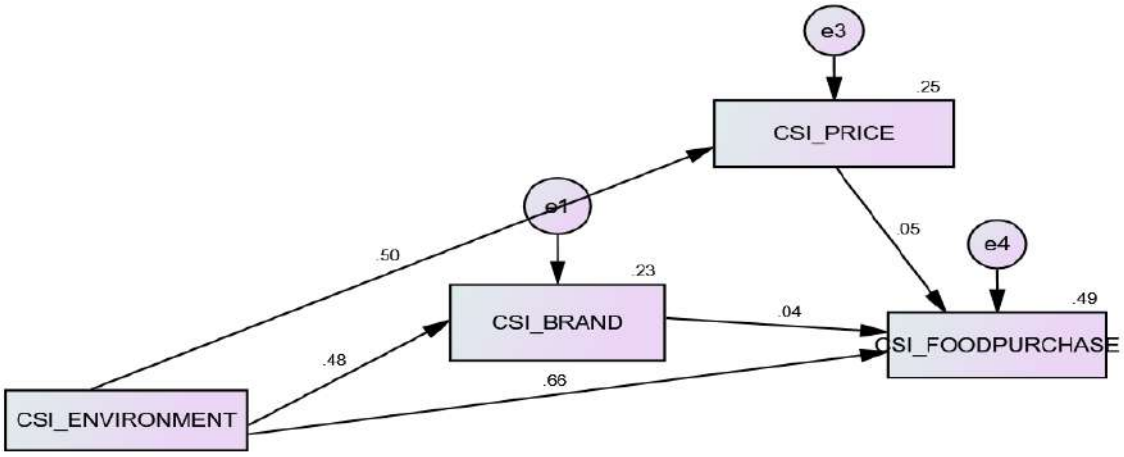

Figure. 1. A graphical representation of the Structural Equation model

RESEARCH ARTICLE

COA based FOPID Controller for Maximum Power Generation in PV System under Partial Shading Condition

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ABSTRACT

Nowadays, Renewable energy resources play a significant role in electric power generation. There are various resources such as PV, wind, geothermal and so on. The PV is a good choice for power generation because it is an everlasting energy resource and environmentally friendly too. Since the efficiency of solar PV panel depends upon the irradiance level, for the extraction of maximum power from the PV power generation system. This paper has been introduced a novel approach based MPPT technique for improving the performance of the PV system using Chimp Optimization Algorithm (COA) based Fractional-Order Proportional-Integral- Derivative (FOPID) controller. To simulate the panel power and justify the efficiency of the proposed algorithm by various simulations results are carried out using MATLAB/Simulink software. The result reveals that the proposed method can effectively increase the system efficiency with fast, better dynamic response and enhanced regulated output power compared to the conventional techniques such as Ant colony at different partial shading conditions.

Keywords: Partial shading condition, MPPT technique, PV system, FOPID controller, COA

INTRODUCTION

In recent years a PV based power generation has been identified for electricity. The produced power by the PV system depends on climate changes like irradiation and temperature falls on the PV module [1, 2]. The PV cells are

able to convert sunlight into electricity accordingly. The voltage at which PV module can produce maximum power is called Maximum Power Point (MPP) or peak power voltage [3, 4]. For extracting the highest possible power and to maintain the MPP in the PV panel, different types of algorithms are required to operate the MPPT controller under enormous weather changes [5]. The fractional short circuit current has taken the initial operating point and then it moves to conventional P&O method which can improve the tracking efficiency with low power oscillation [6]. An adaptive perturbation size has been generated by multiplying a two-dimensional Gaussian function with an Arctangent function and the time of the next duty cycle has been computed by variable perturbation frequency which improves the dynamic and steady state performance of the PV system [7, 8]. A high voltage gain DC-DC converter with P&O algorithm has been implemented for low power applications with low cost [9]. The differential power algorithm has been calculated to find the difference of successive powers with corresponding voltages which generates the duty cycle of the boost converter to track the MPP effectively [10, 11]. The fractional order with fuzzy logic method can reduce the oscillation with high speed and tracking accuracy compared with conventional fuzzy logic control method under varying climate conditions [12]. An auto-scaling variable step-size method has automatically adjusted the step size which can eliminate the troubles in conventional variable step size method and reach the stable output power with fast dynamic response [13]. The hybrid P&O and learning automata algorithm validate the performance of the PV system and compared with conventional and modified P&O algorithms, under different input conditions the tracking speed is high with less oscillation [14]. The Incremental Conductance (IncCond) with direct control algorithm based fuzzy logic duty cycle estimator is used to avoid the degraded performance of the PV system with accurate and faster in the era of stable state and dynamic conditions with oscillation free [15]. The modified IncCond method is used for avoiding the confusion in the first step change of duty cycle in the converter with zero power oscillation [16]. The IncCond algorithm controls the two different boost converter topologies which tested the speed and efficiency of the PV system [17].

The P&O algorithm is used to avoid the power losses in dynamic conditions due to the operating point fluctuations in the MPP region, the MPPT controller parameters has been modified based on the duty cycle of the boost converter [18]. The P&O based MPPT algorithm is used with buck and buck-boost converter topologies to improve the steady state and dynamic performance of the PV system. The fluctuations are suppressed effectively in buck converter than buck-boost converter [19]. The performances of the parameters are obtained by PID controller based artificial intelligence technique with free of over shoot, less settling time and high-rise time [20]. The objective of this work is to reach the MPP of the PV system using digital feedback controller with Classical techniques of maximum power tracking. The issue of MPPT has been addressed in different ways in the literature. In this proposed work developed a FOPID controller with different MPPT algorithms to achieve maximum efficiency of the PV system. The remaining sections of this paper are prepared as follows. Section 2 describes the recent research works of MPPT controller. The proposed architecture is explained in Section 3. In Section 4, the performance of the MPP tracker using proposed algorithm with FOPID controller is evaluated with simulation results. Section 5 ends with conclusion.

A Recent Research Works: An Overview

Many different DC-DC converter designs with MPPT controller are available in PV system. Few papers are reviewed in this section. Chapping Rao *et al.* [21] have introduced high-voltage DC-DC converters with sophisticated transmission capability for PV applications. A minor amount of induction combined with a magnetic center was used to improve the introduced converter voltage conversion rate. The converter can be a dynamic MOSFET with low directing resistance, thus reducing the transmission hazards and the complexity of the control area. Because of low information current wave, the lifespan of the information PV board is extended and the PV module MPP can be simply followed. The zero-voltage and current transmission of the MOSFET and the diodes are another facet of the introduced converter, which improves its efficiency. Furthermore, P&O calculation was introduced, which was enhanced by supporting the confiscated power of resources. Imane Ide *et al.* [22] created an independent PV utilized Three-Level Boost (TLB) converter also developed an advanced MPPT control. The introduced MPPT technique relies in an intelligent irritation and notification calculation using the Artificial Neural Network (ANN) and P&O to decrease movements in MPP. Before time, ANN gives current and voltage in MPP to several solar orientation radiation and temperature of cell. And fully hold to the PV generator MPP for daylight brightness and a

comparatively essential Proportional Integral (PI) regulator is added to guarantee the voltage of TLB capacitor equilibrium. Muhammad Hamza Zafar, Thamraa Al-shahrani *et al.* [23] have presented a PV system efficiency was significantly reduced by the intrinsic non-linear model, MPP, and partial shading (PS) effects. These two problems cause major power loss. To devise the maximum power point tracking (MPPT) control of the PV system, a group teaching optimization algorithm (GTOA based controller was presented, which effectively deals with the PS and complex partial shading (CPS) conditions. Four case studies were employed that included fast-changing irradiance, PS, and CPS to test the robustness of the MPPT technique. Sergey Obukhov, ahmed ibrahim *et al.* [24] have analyzed the PSO algorithm has shown that there is currently no methodology for the optimal parameters' selection of PSO algorithm based maximum power trackers for the PV system. That aims to create a convenient and reasonable method for choosing the optimal parameters of the PSO algorithm, taking into account the topology and parameters of the DC-DC converter and the configuration of solar panels. A presented method for selecting the parameters of a buck converter connected to a battery. The optimal value of the sampling time for the digital MPP controllers, providing their maximum performance has been determined based on a methodology. The actual problem of the practical application of PSO is the determination of its parameters to ensure high effectiveness of extracting the global MPP.

DESIGN OF PROPOSED METHODOLOGY

In this proposed methodology, the PV has been analyzed and studied. To analysis the PV system, the analysis has been implemented and validate the efficiency of the proposed method. The proposed system is utilized to compute the parameters of the PV system in terms of losses and efficiency. The three types of analysis are presented in the PV system such as viability, technical sustainability, validating and justifying the environmental conditions. The main objective of the work is to design an PV for meeting the load demand in the load side. The proposed PV system is mostly utilized given the electrical load of different applications. In the PV system, it generates power based on solar energy. The generated power is sent to the load. Sometimes, the environmental conditions may be affecting the generated power. For this reason, MPPT is developed to manage the different weather conditions. In the proposed MPPT controller, the error power is computed which is corrected by providing the optimal pulses to the DC-DC boost converter. The optimal pulses are computed based on the FOPID controller. In the FOPID controller, the optimal pulses are selected with the help of the COA algorithm. A detailed description of the FOPID controller and COA is presented in the section.

FOPID controller

The proposed integral controller, the FOPID controller is used to reduce the error of different parameters of PV power. Based on the differentiation and integration of non-integer order. The fractional order controller may work related on fractional order differential equations. The general PID controller have three different control parameters such as proportional, integral and derivative controllers. The PID controller performance may be improved with the consumption of adding two parameters and form FOPID controller which increase two control parameters [25]. The FOPID controller may be mathematically presented as follows. The main difference among PID controller and FOPID controller is, FOPID controller have extra two control parameters and the derivation order are not an integer value. This behavior provides additional degrees of freedom for tuning the controller which encourage the best dynamic parameters with contrasted of conventional PID controller. In recent years, compared with PID controller, the FOPID controller have best performance of controlling error values of PV system. The FOPID controller output is mathematically formulated and presented as follows,

$$U(t) = K_p E(t) + K_I D_t^{-\lambda} E(t) + K_d D_t^{-\mu} E(t) \quad (1)$$

$$E(t) = \Delta P_{tie}(t) + B_i \Delta\omega_i(t) \quad (2)$$

The transfer function of FOPID controller is presented as follows,

$$G(s) = K_p + \frac{K_i}{S^{\lambda}} + K_d S^{\mu} \quad (3)$$

The reference value is compared with the present value of PV power to compute error values which are denoted by E(t) and the control signal of the system is mentioned as U(t). The FOPID controller parameters have five parameters that provide the best results to improve performance of system. Various PID controller parameters tuning methods can be utilized for decentralized power system load frequency controller. The universal progression procedure of such a COA algorithm has worried theorists in the area of parameter to control enhancements. Due to thought by means of transmissible managers, the computational complexity of this populace-related computations is prolonged [26]. The searching behavior is appropriate for representative in addition understanding of transformative classes, hereafter it utilized as a progression computation as a section of reappearance action of force microgrid system. In the COA algorithm, the step length in addition to a unit length of the direction of that chimps can be defined randomly. In this way, the optimal solution convergence time is expanded for guaranteeing the given issue. In this paper, the COA algorithm is proposed to control the MPPT of the PV system and the proposed PV-based MPPT controller with an integrated system. The COA process is presented below section.

Chimp Optimization Algorithm

In this proposed methodology, COA is utilized to compute the optimal FOPID parameters for extracting maximum power from the PV system. The general mathematical formulation of COA is presented as follows,

Inspiration

Normally, the fission-fusion society is a chimp's society. This is considered as one of the societies, the combination of society may be time-variant function. Additionally, in society, each member has a specific duty and special ability that may change over time. From the consideration, the aim of independent concepts is developed in this algorithm. Hence, every group of chimpanzees separately attempts to find the search space with its singular characteristics intended aimed at specific duty. Generally, four types of chimps are presented such as attackers, chasers, barrier, and driver. Based on these types, the behaviors of the chimps in the hunting process are changed for efficient hunt operation. In the chimp's algorithm, the drivers have collected the prey without doing the hunting process [27]. Barriers residence themselves in plants to create a dam crossway the leakage route of the prey. The preys are grabbed by chasers rapidly. At last, the attackers are identifying the escape route of the prey down into the inferior canopy. Attackers are required to have more efficient in identifying the proceeding change of prey. Moreover, the attackers have been collected with the meat larger piece after an efficient hunt. In Chimp calculation, the attack method is strictly related to actual ability, intelligence, and age. Also, Sims can change practices during a particular chase or interact with their strategy as a whole. It is authorized by the chimps of Chase to execute meat in exchange for social honors such as preparation and firm assistance. Henceforth, by opening another domain of interest and benefits. chimp may indirectly affect the chase. People use social motivation as chimps. In this way, the chimps have an advantage compared to other social predators. In addition to sexual motivation, start the sims to act turbulentally at the last advance of the chase. Therefore, bulk chips drop the mistakes of obtaining meat independently. From the thinking of the social behavior of the Sims, it can be isolated into two primary stages, such as investigation and misuse. There is a way to track, prevent and drive prey in the investigation. Misuse is considered a prey attack. Details of misuse and investigation numbers are introduced as follows,

Driving and chasing the prey

In the COA, the prey can be hunted throughout the exploitation and exploration stages. The mathematical design of chasing also driving prey is formulated as follows,

$$D = \left| c.x^{prey}(T) - M.x^{chimp}(T) \right| \quad (4)$$

$$x^{chimp}(T+1) = x^{prey}(T) - A.D \quad (5)$$

where, x^{prey} , x^{chimp} can be described as position vector of chimp and prey, T can be described as a number of current iterations, and A, M and C can be described as coefficient vectors. The position vectors of the COA is computed based on the below equation,

$$A = 2.F.R^1 - a \quad (6)$$
$$C = 2.R^2 \quad (7)$$
$$M = \text{Chaotic Value} \quad (8)$$

where, R^1 and R^2 can be described as random parameters which in the variety of [0,1], F can be described as coefficient which decreased non-linearly from 2.5 to 0 by the iteration procedure (in both explorations also exploitation). M can be described as a chaotic parameter computed based on different chaotic maps. Hence, the vector describes the behavior of sexual incentive of chimps in shooting behavior. The fitness function of the COA is presented below,

$$FF = \text{Min}\,(E(P)) \quad (9)$$

where, E(P) can be described as an error value of PV power. The error value is minimized by selecting the optimal FPOID parameters. A complete description of the vector value is explained in the next section.

Exploration phase

The attack behavior of the chimp's mathematical model is designed as follows, firstly, the chimps can provide the location of the prey, and secondly, they can orbit it. Finally, predators are generally maintained by attackers. The chaser, barrier, and driver are usually involved in the hunt. At the research stage, there was no information about the optimal condition of the prey during the initial repetition [28]. This state of the chaser, block, and drive must be updated using the attacker's status. So, four optimal solutions can be saved and the other chimps are stopped to update the positions related to the locations of the best chimps. This creation is presented mathematically as follows,

$$d^{Attacker} = \left|C^1X^{attacker} - M^1D\right| \quad (10)$$
$$d^{Barrier} = \left|C^2X^{barrier} - M^2X\right| \quad (11)$$
$$d^{Chaser} = \left|C^3X^{Chaser} - M^3X\right| \quad (12)$$
$$d^{Driver} = \left|C^4X^{driver} - M^4X\right| \quad (13)$$
$$X^1 = X^{Attacker} - A^1\left(d^{Attacker}\right) \quad (14)$$
$$X^2 = X^{Barrier} - A^2\left(d^{Barrier}\right) \quad (15)$$
$$X^3 = X^{Chaser} - A^3\left(d^{Chaser}\right) \quad (16)$$
$$X^4 = X^{Driver} - A^4\left(d^{Driver}\right) \quad (17)$$
$$X(T+1) = \frac{X^1 + X^2 + X^3 + X^4}{4} \quad (18)$$

The search agent position is updated in the search space based on another chimp position. so, the chimp final position is arbitrarily placed in the orbit which is described as drivers, chaser, barrier, and attacker positions.

Exploitation phase

As beforehand mentioned, the chimps will hunt the victim by attacking process while the prey stops running. In the attacking process of chimps, the value of f is linearly minimized. The vector of a also reduced in the manner of f vector. Additionally, the a is an arbitrary variable in the interval of $[-2f, 2f]$. Additionally, COA chasing, blocking, and driving mechanisms have reinforced exploration capability and it may still be at the risk of local minima trapping conditions. Hence, the exploration is a required portion to achieve the best results. In COA, chimps deviate to attack the prey and converge to attack the prey [29]. The vector a is located to mathematical design this characteristic so that inequality parameters. To avoid local optima entrapment, the chimps are forced to diverge from

prey which is formulated as $|a| > 1$. To achieve global optima, the chimps are forced to converge at prey location which is formulated as $|a| < 1$.

Exploitation phase using the social incentive

In the COA, the social incentive and society of chimps which related to meat hunting. In the final stage of the chimp hunting process, the chimp may abort its hunting process. Hence, they chaotically attempt to grab hunting meat for social essences. These characteristics of the chaotic map are designed with chaotic maps which is formulated as follows,

$$X^{\text{chimp}}(T+1) = \begin{cases} x^{\text{prey}}(t) - A.D & \text{if} \quad \mu < 0.5 \\ \text{Chaotic value} & \text{if} \quad \mu > 0.5 \end{cases} \qquad (19)$$

where μ can be described as an arbitrary number in the interval of [0,1]. Initially, they generate the random population of chimps. Secondly, all chimps are arbitrarily divided by different groups such as driver, chaser, barrier, and attacker. After that, every chimp position updates the f coefficients with the consideration of the own group method. The optimal prey location is identified in the iteration based on driver, chaser, barrier, and attacker. Then the distance from the prey, the positions are updated. Additionally, the optimal tuning of the m and c, the fast convergence rate and faster. Additionally, the value of f can be adjusted from 2.5 to 0 which empowers the process of exploitation. Finally, the condition of the divergence and iterations are checked which provides the optimal results to manage the results.

RESULTS AND DISCUSSION

In this section, the performance of the proposed integrated technique implemented in MATLAB/SIMULINK working platform is described. In order to analyze the proposed control technique, PV system is used. Figure 7 shows the PV system connected with the proposed control methodology. The performance analysis of the power of the PV is analyzed and illustrated in figure 4. According to the variation of the solar irradiance, the maximum output power is tracked. The generated power is usually provided to the nonlinear load by means of the transmission lines. Here, the control pulses generation of the converter is obtained by utilizing the proposed technique, which is based on the voltage and current of PV panel. The proposed method elegantly utilizes the voltage and current values as the input. In the event the procedures come to an end, the proposed method becomes well-geared to generate the optimal control pulses of the converter. The PV system performance can be improved with the proposed controller. The MPPT controller is mainly focused related to converter for compensating load demand when partial shading condition is occurred. To analysis the performance of PV system is analyzed with two different cases, constant irradiance condition and ramp irradiance condition.

Performance analysis

In this subsection, the performance evaluation of the proposed system and its simulation results are analyzed for the change in solar irradiance and for the time instants t=0 to 0.25 seconds. Here, the solar irradiance is analyzed in two cases

- **Case 1:** Analysis of Constant Irradiance
- **Case 2:** Analysis of Ramp Irradiance

Case 1: Analysis of Constant Irradiance

In this case, the renewable energy resources are constant that represents the irradiance of PV is assumed to be (1000 W/m^2). For the visual representation, the irradiance is depicted in the figure 3. Based on the analysis, the generated power of PV is measured and illustrated in the figure 4. The approximate generated power of PV is 2900 W. In this case, the load is varied and the load demand is assumed to be 6000W, 8000W, 12000W respectively. For the optimal power management, the condition to be checked, it must meet the load demand. Then only, the optimal

power flow is achieved. For the demand variation, the corresponding generated power and grid power is analyzed. The pictorial representation analysis is depicted in the figure 5. In this case the load demand variation is applied at the different time instant. Initially, the time instant t=0-0.7sec, the load demand is assumed to be 6000W and the generated power from the input sources are analyzed at the same time instant. Based on the analysis, the power is maximum achieved and meets the load demand. After that, the next time interval t=0.7-1.3sec, the demand is assumed to be 10000W and evaluated the generated power from the renewable resources and energy storage devices are also meet the load demand which is represented in the figure 5(b). Similarly, the load is varied after the particular time instant, and then assumed the powers. To meet the load demand, again the generated power is evaluated. For the optimal process of power management, the distributed control is developed. When the load demand power is increased, the battery is providing the extra power to the grid for compensating the demand power in the grid connected PV system. For example, the generated power is 5500W at the time of 0s to 0.7s and that time load demand is 6000W. The PV power must be meet the demand, but the demand is not to meet means, the required power is generated from the battery. Suppose, the excess power is generated from the inputs means, that is stored from the energy storage devices. The power management is working based on the real and reactive power control. The analysis of achieved output grid power is represented in the figure 6.

Based on the proposed distributed control, the real and reactive power management is done. In addition, the proposed controller is developed by utilizing the proposed algorithm. For the voltage regulation loop, the optimized FOPID controller gives the dc link voltage as constant. In the current controller loop, the maximum current is extracted from the proposed controller. For the optimal tuning process, the controller gain parameters are effectively tuned and produced the optimal results. The performance analysis of dc link voltage is described in this figure 7 at the time instant t=0-2sec. Actually, the reference voltage is 310 V and need to maintain the dc link voltage as constant with the reference voltage. Initially, the dc link voltage is 0V at the time instant 0-0.1sec then gradually increases with equal to the reference voltage. After that, the dc link voltage is moving on with the stable condition. Using this dc link voltage, the comparison analysis is achieved for this case it is presented in the next section 4.2. Similarly, the case 2 performances are analyzed and described in the following.

Case 2: Analysis of Ramp Irradiance

In this case, the performance analysis PV irradiance variation is depicted in the figure 8 (a) and the irradiance of PV is assumed to be changed from1000 w/m^2 . Based on the PV variations the generated power also varied but it meets the demand. In the figure 8 (b) represents the generated power of the PV that is 1500W. The PV generated power are used to meet the load demand of the grid side. Here, the load demand is assumed to the constant load of 8000 W. Hence the demand and total generated power is described in the Figure 9. Our main objective is to compensate the load demand when load maximum or minimum. The distributed control analysis achieves the compensation of load demand through the control of power. The load demand is compensated with the generation power of the renewable sources, battery. In this case, the total generated power is 8000W. Actually, the demand is 8000W, at that time the generated power is also 8000W, so the power demand is compensated. This power management process is achieved through the utilization of the distributed control of real and reactive power and proposed algorithm. The analysis of the output power is described in figure 10.

Comparison Analysis

In the sub section, the comparison analysis is done for the above two cases. The comparison is done with the existing control techniques of the ACO and PSO algorithms. The dc link voltage and generated power are compared with the existing method. This analysis is used to know about the ability of the proposed method. The proposed method effectiveness is calculated based on the rise time value. Based on the figure 11 (a), the proposed technique rise time is t=0.01-2.0 sec at 310V. The PSO method rise time is t=0.015-2.0 sec at 300V. The ACO method rise time is t=0.016-2.0 sec at 280V has been performed. The dc link voltage analysis is compared with two existing algorithms of ACO and PSO. In comparison, the proposed algorithm has a higher efficiency; it is proving the pictorial representation. In figure 11 (b) the proposed technique rise time is t=0.01-2.0 sec at 310V. The PSO method rise time is t=0.015-2.0 sec at

300V. The ACO method rise time is t=0.016-2.0 sec at 270V has been performed. The dc link voltage is 310V, the proposed method only meets the level of voltage and maintains constant but the existing methods do not meet the constant value of the dc link voltage. Based on the voltage level, the proposed method has high efficiency with compared tp existing methods.

Figure 12 represents the generated power comparison analysis of case1 and case 2. The comparison analysis is calculated based on the compensated demand. In order to prove the effectiveness of the proposed method, this is compared with the existing methods such as PSO and ACO method respectively. In figure 12 (b), the demand is 8000W but the ACO method only satisfied the demand up to 6800W and the PSO also satisfied the 7200 W demand only. Based on the demand the proposed method satisfies the full demand from the grid side. So, the proposed method has a high efficiency compared to the existing methods. In the proposed technique based distributed control for power management, we assess generated power that has been exploited as a response indication in load demand. The comparison analysis of taking into the account for proves the efficiency of the proposed technique based on the value. The comparisons analysis clearly described in the figures and techniques at various colors.

CONCLUSION

This paper proposes a COA based FOPID tracking technique, which is used in the MPPT controller for PV power generation in the stand-alone power system. In PV system, maximum power extracting during environmental conditions is an essential requirement to manage the different load conditions. In order to gets maximum utilization of available power production from PV power generation system in partial shading condition along with the proposed MPPT controller. The designed DC-DC converter is achieved different advantages such as high voltage gain and output voltage. The advantages of COA techniques has quicker, reliable searching ability and it reduces the computational burden, for this MPPT has work under all types of partial shading condition on the PV panel. The proposed system is implemented in MATLAB/Simulink platform and analyzed with performance metrics of converter and PV parameters. Moreover, the proposed MPPT technique is compared to the existing techniques and the simulation result shows the proposed tracking technique has been track maximum power at minimum time instant hence the tracking efficiency of the system is high as compared to other technique. The proposed design is of highly efficient and accurate tracking of maximum power in partial shading conditions.

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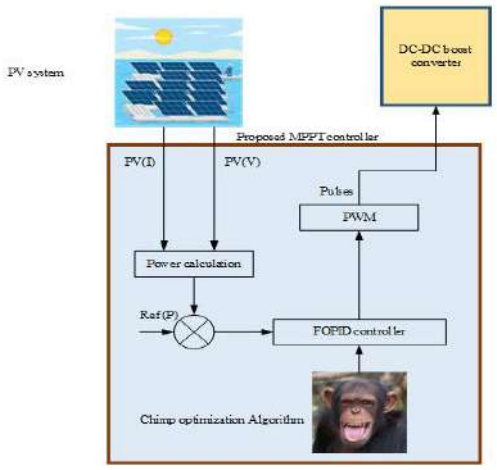


Figure 1: Analysis of Proposed structure

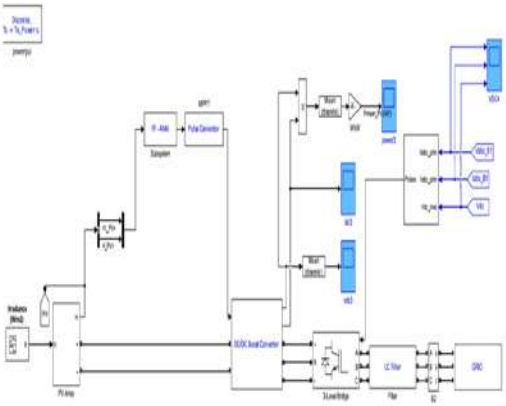


Figure 2:Simulink model of the proposed system

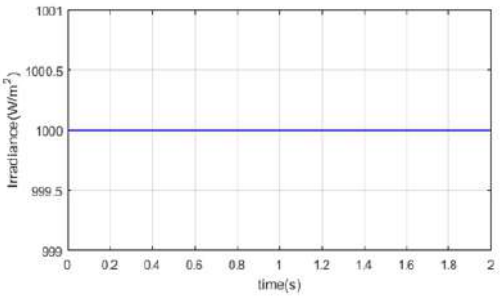


Figure 3. Analysis of Irradiance level

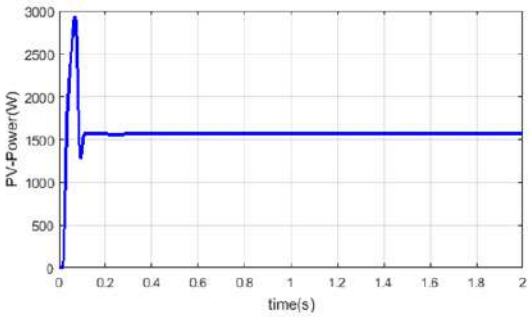
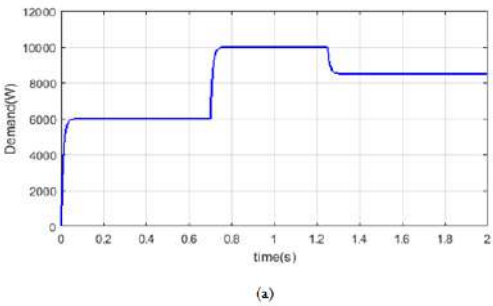


Figure 4. Analysis of PV generated power



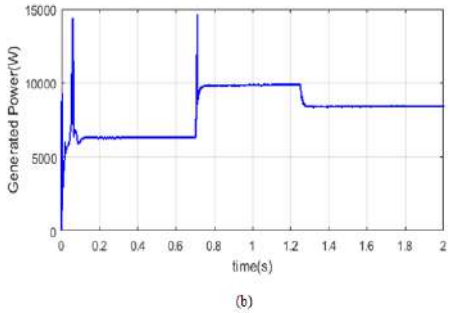


Figure 5: Analysis of (a) Load Demand and (b) Generation power

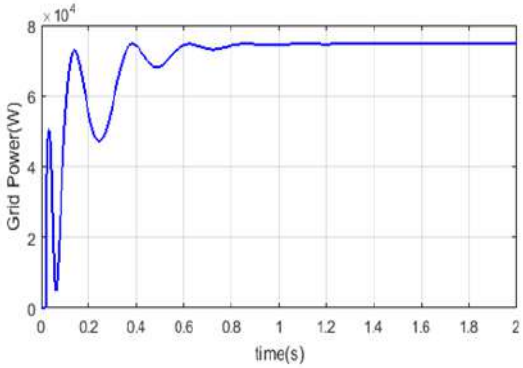


Figure 6: Analysis of the output grid power

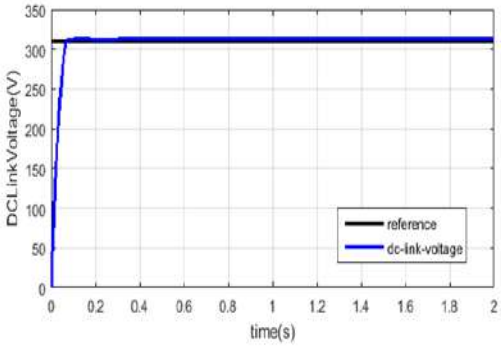
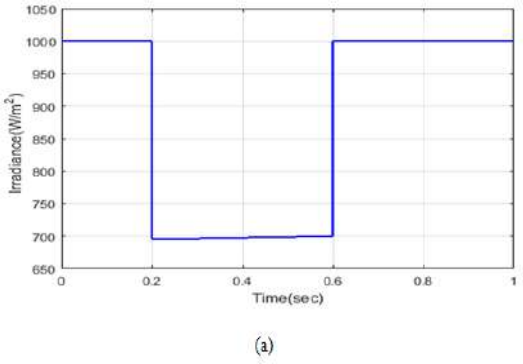


Figure 7: Dc link voltage of the proposed method.



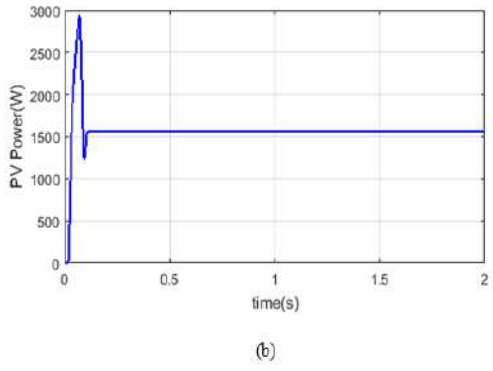


Figure 8: Analysis of (a) Solar Irradiance and (b) power for PV

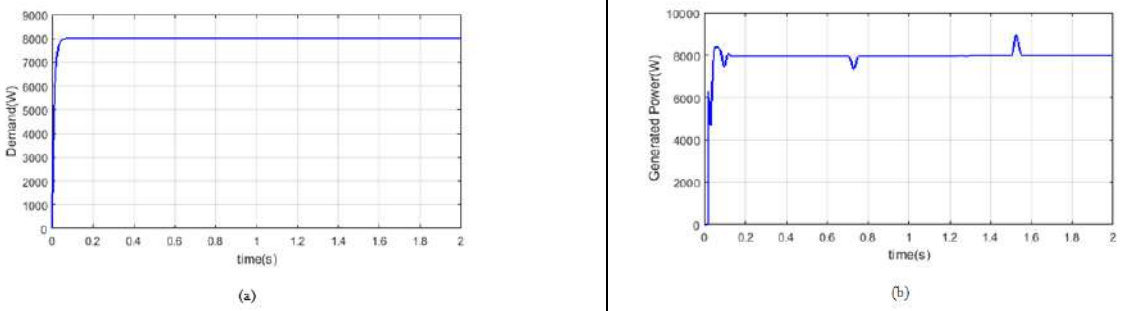


Figure 9: Analysis of (a) Load Demand and (b) Generation power

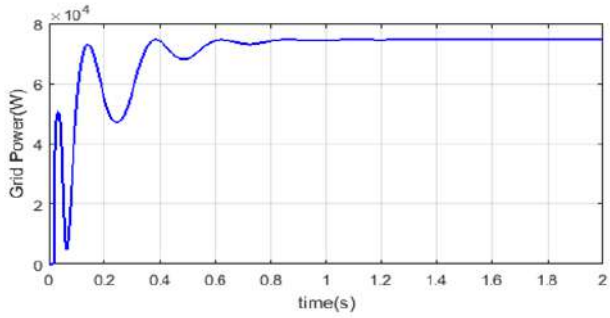


Figure 10: Analysis of the output power

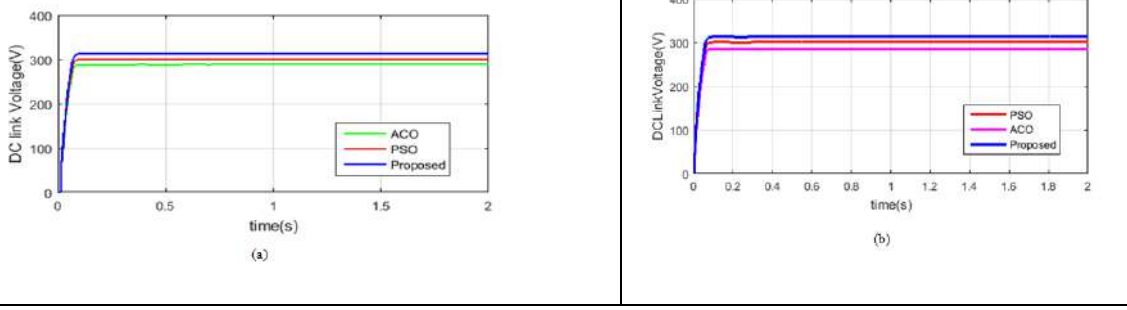


Figure 11. Comparison analysis of Dc-link voltage (a) Case 1 and (b) Case 2

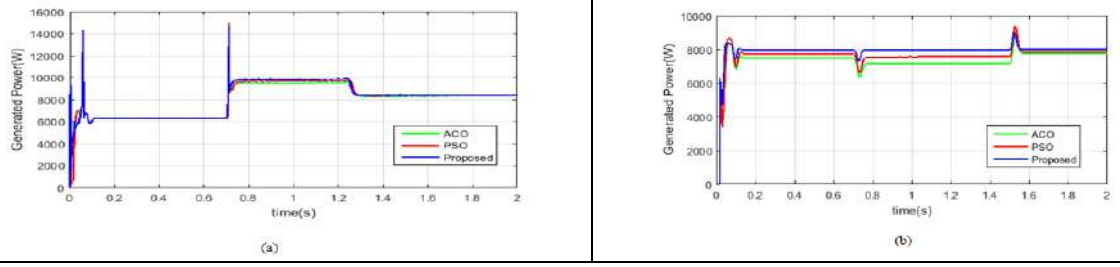


Figure 12. Comparison analysis of generated power (a) Case 1 and (b) Case 2

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RESEARCH ARTICLE

Immediate Effect of Ischemic Compression and Therapeutic Massage Technique on Upper Trapezitis among Working Women - A Comparative Study

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ABSTRACT

Neck pain is commonly seen in the posterior portion of the neck. The upper trapezius muscle lies at the posterior portion of the neck. Hence, Trapezitis is a clinical condition in which there is pain in the trapezius muscle due to severe neck spasm. This condition is treated with conventional physical therapy interventions or other medical interventions. Experimental study was conducted 30 female participants were conveniently selected with a history of trapezitis. Subjects with age group between 20-40 years were distributed into two groups GROUP A (IC) and GROUP B (TM). Initially all the subjects were assessed with VAS outcome measure for pain. GROUP A (IC) received Ischemic Compression technique and GROUP B (TM) received Therapeutic Massage technique over the affected area. To check for significance and normal distribution of both the technique both paired t- test and unpaired t-tests were carried out via SPSS. The result allows us to conclude that the technique of Ischemic Compression provides a much more immediate effect in reducing pain for over a period of 7 days than Therapeutic Massage technique with females suffering from trapezitis.

Keywords: Trapezitis, Ischemic Compression, Therapeutic Massage, VAS, working females

INTRODUCTION

Trapezitis is an inflammatory condition where pain is experienced that arises from the trapezius muscle causing a severe neck spasm. Trapezius is a muscle which has its primary action that is, elevation of the scapula as in Shrugging movement of the Shoulder. Trapezius muscle lies at the posterior portion of the neck. Upper Trapezius

fibers originates from medial one-third of the superior nuchal line and external occipital protuberance and inserts into posterior border of lateral one-third of clavicle.[1] Any strain of the upper fibers of trapezius leads to pain or spasm in posterolateral part of the neck. Trapezitis can be caused due to a lot of factors; but one of the primary factors is faulty posture. Faulty posture may be due to: Sitting for a prolonged period in the same posture while working over a computer or on a desk that causes neck spasm, Driving for over a prolonged period. Other causes may be: Lifting of heavy weights, Uncomfortable and an incorrect sleeping posture with respect to the thickness of the pillow and firmness of the pillow. In ideal conditions to avoid neck spasm a firm, that is, not too hard or not too soft pillow should be used [9]. Trapezius acts as a stabilizer of scapula when abduction of arm is done beyond 90 degree, but while performing a movement that requires abduction of arm along with sideways tilting of the head, it develops tension on the muscle and it causes a strain which leads to segmental spasm of the muscle [9].

Trigger Point (TP) is defined as a spot where certain amount of pain and tenderness is present. It is a focal point present over a particular muscle which gets stimulated and elicits pain response upon palpation. Ischemic Compression is therapeutic technique which manually aims to deactivate a particular TP. Direct sustained digital pressure with enough force for a time interval decreases blood flow to the area. Hence, the tension in the affected muscle is reduced. The digital pressure is regularly applied, maintained and step by step released. Ischemia involves transient lack of blood supply, slight congestion and associated tissue reaction.[7] The motive of ischemic compression is to increase the blockage of blood to a given region so that, upon release, there might be a gushing of blood supply over the affected area. It will remove the metabolic waste products, provides required amount of oxygen and facilitates the affected muscle or specific tissue to heal. This boom or increased amount of blood flow to the affected location is called as hyperaemia. For the application of IC over a given trigger point of a particular muscle, the muscle is kept in a relaxed and stretched position. Initially, the thumb or any other strong finger is firmly pressed over the TP directly to create a tolerable pressure, and the pressure is sustained.

Once the amount of discomfort or irritation caused due to pressure subsides a bit, Pressure is gradually increased by the addition of a finger or a thumb of the other hand to reinforce it as much as necessary. The process is continued up to 60 seconds or so with 20-30 m lb of pressure. The procedure can be repeated after a hot pack and AROM if TP tenderness persists[7] Massage therapy is defined as a therapeutic manipulation using hands which includes numerous specific and general techniques that are often used in a specific sequence, such as effleurage(stroking), petrissage (kneading), and percussion. Features of massage includes any technique, be it manual or mechanical, which imparts mechanical energy to the soft tissue of body through the skin without producing any change in the position of the joint, in order to elicit certain physiological or psychological effect which can be utilized for therapeutic, restorative or preventive purpose either on sick or a healthy individual can be defined as massage.[8] Physiological Effects of Massage: As a therapeutic technique Massage is used to relieve pain, to decrease swelling, muscle sprain, tension and anxiety associated with disorders, restrictive movements, affecting muscular, nervous, cardio respiratory and other systems.[8] VAS or Visual Analog Scale is a scale used to measure the intensity of pain in population suffering with different diseases depending on the severity of their condition. It is usually 10 cm (100 mm) in length. It is a single item scale used for the pain. Greater the pain, higher the score and Lower the pain, lowest the score [5,6].

MATERIALS AND METHODS

Study Design
Experimental Study

Sampling
Convenient Sampling

Participants
30Female subjects suffering with upper trapezitis pain and working for 8.5 hours or more will be included for the study based on criteria for selection.

Outcome Measure
Pain Scale-VAS (Visual Analog Scale)

Duration of the study
7 days or for 1 week.

Research Centre
Zydus Hospitals, Ahmedabad

Materials Used
1. Stool
2. Table
3. Record or data collection sheet
4. Consent form
5. Cream
6. Paper
7. Pen
8. Pencil

Inclusion criteria
1. Female subjects.
2. Working Woman 8.5 hours or more.
3. Patients with age 20-40 years.
4. Sub acute condition.
5. Subjects who are diagnosed with upper trapezitis.
6. Subjects who are willing to participate.
7. Unilateral trapezitis.

Exclusion criteria
1. Any other cervical instability and other degenerative disorder.
2. Recent surgery in and around shoulder and cervical region.
3. Thoracic outlet syndrome.
4. Cervical radiculopathy.
5. Skin disease and infection.
6. History of whiplash injury.

Total 45 patients were assessed for participating in the study out of which 4 patients did not meet the criteria for selection, 6 patients refused to participate and 5 left due to other reasons and so finally 30 patients were included in this study. These 30 patients were then assessed based on history taking, inclusion and exclusion criteria, palpation of affected area and examination of all movements of cervical ROM. After the initial assessment, patients were explained about both the techniques that is, Ischemic Compression and Therapeutic Massage technique and their consent was taken for the same.

Group A After the subjects have rated their level of pain on a scale of 0 to 10, Moderate digital pressure is applied over the identified area of pain or to be specific the Trigger point. Now in case if the pain is not identified, the pressure will be increased and if the pain is generated or identified over a particular spot the pressure is sustained

over the specific TP as the point of ease will be identified. The position of comfort for the affected muscle is the one in which the muscle is in its most relaxed and shortened position. Ease or comfort can be defined as the spot where the pain reduction is up to 70%. For the Upper Trapezius, the relaxation position is: High sitting with placing the forehead over the dorsum of both the hands which are crossed and kept over the table. Irrespective of this, the position of ease also depends on the comfort and relaxation of the patient which can be subjective in nature.

Once the subject is in the position of comfort for the affected muscle, it will be held for 15-25 seconds and repeated for over 3-5 times as per subject's tolerance and severity of the pain and condition. Group B After the pain scale is taken the subjects are positioned sitting comfortably with placing the forehead over the dorsum of the both hands which are crossed and kept over the table. Now with the aim of increasing blood flow in the direction over the affected part the hands should be continuously and rhythmically passed over it. The position also depends on the nature and the type of pain present of that area. Once the position is taken 4-5 strokes of effleurage are given. After that, Kneading is given at the particular area. Continuing further, the hacking is given where it produces the peculiar sound. After that ending with effleurage over the area and draining it into the supraclavicular lymph nodes.

RESULT AND DISCUSSION

Total 45 patients were taken from which15 were excluded and finally 30 patients with upper trapezitis pain were taken as subjects in this study. These 30 patients were randomly divided into two group, 15 subjects in Group A or IC were given Ischemic Compression and 15 subjects in Group B or TM were Therapeutic Massage technique. The data was entered and analysed by using SPSS (statistical package for social sciences) software version 20. Significance tests for difference in means was done using paired t-tests. The test was applied as the data followed the condition of normality.

GROUP IC
Ischemic Compression Group
GROUP IC
Pre and Post Mean Vas

Group IC was given Ischemic Compression technique for 20- 30 seconds for 3-5 times continuously for 7 days. After the 7- day intervention the pain was measured with VAS. The final score of pre- treatment mean VAS of IC= 65.13 and post- treatment mean VAS of IC = 35.06.

Graph 1.1: Within The Group Comparison of Mean Vas Values Pre And Post Intervention.
Table 1.1 : Within Group Mean Difference Comparison Done With Paired T -Test
Table 1.2 : Within Group Mean Difference Comparison Done With Paired T- Test Group
Table 1.3 : Comparison of Between Groups Done With Unpaired T- Test
Graph1.3 : Comparison of Between The Groups.

All of the above were shown between two group comparisons. Unpaired t-test was used and P- value < 0.05. So, statistically proven that there was significant difference between GROUP A or IC (ISCHEMIC COMPRESSION) and GROUP B or TM (THERAPEUTIC MASSAGE) in Working Females suffering with Trapezitis, but GROUP A or IC (ISCHEMIC COMPRESSION) is more effective to reduce pain than GROUP B or TM (THERAPEUTIC MASSAGE). Hence alternative hypothesis in favour of Ischemic Compression technique (1) is accepted and null hypothesis (H0) of no difference is rejected.

DISCUSSION

Trapezitis is basically an inflammatory condition of the trapezius muscle where a person experiences pain and spasm particularly at the posterior part of the neck. The study mainly focuses on determining the more effective treatment in case of females who are suffering with trapezitis. 30 subjects were selected that were suffering from trapezitis, 15 in each group were randomly divided. One group was given Ischemic Compression technique and the other group was given Therapeutic Massage technique. In this study the major amount of population consisted of females working in a multispecialty hospital setting who have 8.5 or more hours of working and have more of physical activity like mobilizing patients or standing for maximum period of time, and so mainly Nurses and Physiotherapists were taken.

A similar study done by Evandrocardo so dos santos, Rubiandiegoandrado *et al* which describes that the nurses working in hospitals are particularly prone to have Musculo-skeletal disorders which are work related, as a result of faulty posture, continuously mobilising patients and due to that extensive use of the upper limb musculature. They also have lack of sufficient sleep and rest. Therefore, this study supported our idea that nurses have a high prevalence rate of suffering from musculoskeletal pain with the upper and lower back, neck, shoulders, ankles/feet, and wrists/hands being the most affected parts or regions of the body respectively.[3] The first technique used in our study is Ischemic Compression. Shweta Rakholiya *et al* had performed a similar study on determining the effectiveness of Ischemic Compression technique in comparison to daily physiotherapy treatment in the form of Ultrasound and stretching of muscle. 20 female subjects were taken are divided into two equal groups of 10 each. In this study, they stated that Ischemic Compression results in blockage of blood to the affected area so that, upon gradual release, a boom (increase)of blood flow is observed.

It helps in reducing tension over the muscle by the application of moderate digital pressure, drains away metabolic waste products, supplies required oxygen and facilitates the affected muscle or specific tissue to heal much faster as compared to Daily physiotherapy Treatment. Hyperaemia is termed as the increase in blood supply to an area.[1]The second technique used in our study is Therapeutic Massage technique. LingJunKong *et al*. had performed a similar study on Massage Therapy for Neck and Shoulder Pain: A Systematic Review and Meta-Analysis where a Randomized controlled trials (RCTs) of Massage Therapy for patients suffering with neck and/or shoulder pain were taken. There were no limitations on the participant's age, gender, or nationality. The main intervention given to these patients was MT basically with use of hands or mechanical devices. In this research study they stated that Massage Therapy has a significant amount of immediate effect in reduction of pain in patients suffering with Neck and Shoulder pain. With the use of techniques like Effleurage, Kneading and Percussion it provides a certain kind of relaxation to the strained muscle and reduces pain but is found to have a temporary immediate effect on pain.

Hence, they concluded that Massage Therapy provides immediate effect on neck and shoulder pain but other Active Therapies of Pain Relief may show better effects than Massage Therapy. Therefore, in our study we found Therapeutic Massage to be a significant and effective treatment but as stated in the above study other therapy or techniques may show much better effectiveness in alleviating pain and reduction of stiffness of the Trapezius muscle. Henceforth, In our study both the techniques Ischemic Compression as well as Therapeutic Massage have shown significant effectiveness to our outcome measure that is, Reduction of Pain measured with Visual Analog Scale (VAS) but Ischemic Compression technique (<0.001) is found to be better than the Therapeutic Massage technique in alleviating the clinical sign of pain.

CONCLUSION

The results allow us to conclude that the ischemic compression technique is effective for improving the clinical signs of pain in the working females with upper trapezitis compared to therapeutic massage.

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Tables and graph

Table 1.1: Within Group Mean Difference Comparison Done With Paired T-Test
GROUP IC: Is chemic compression

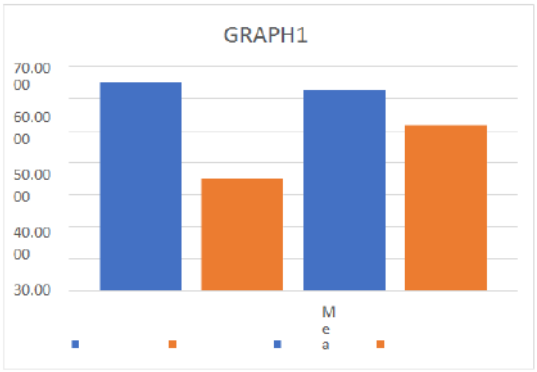
OUTCOME	MEAN DF±SD	PAIREDT-TEST	P–VALUE
VAS PRE-POST	30.06 ± 6.56	17.74	<0.01

Table 1.2: Within Group Mean Difference Comparison Done With Paired T-Test
GROUP TM: therapeutic massage

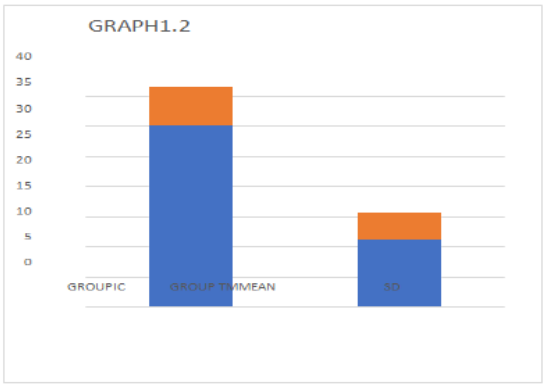
OUTCOME	MEAN DF±SD	PAIRED T-TEST	P–VALUE
VAS PRE-POST	11.13 ± 4.58	9.41	<0.01

Table 1.3: Comparison of Between Groups Done With Unpaired T-Test
GROUP IC : Is Chemic Compression Technique
GROUP TM : Therapeutic Massage Technique

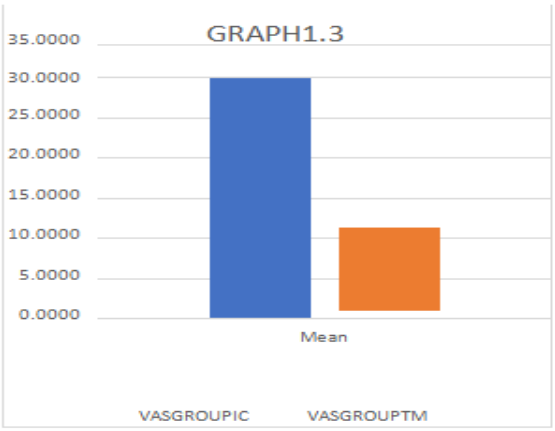
OUTCOME	MEAN DF±SD	UNPAIRED T-TEST	P–VALUE
VAS GROUPIC	29.40 ± 6.31	9.07	<0.01
VAS GROUPTM	11.13 ± 4.58	9.07	<0.01



Graph 1. Within The Group Comparison of Mean Vas Values Pre and Post Intervention



Graph 2. Within group mean and sd comparison



Graph 3. Comparison of Between The Groups.

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RESEARCH ARTICLE

Relationship between Auto antibodies and Cardiovascular Events in Women with and without the Polycystic Ovarian Syndrome

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ABSTRACT

The most prevalent endocrine disorder in women is a polycystic ovarian syndrome (PCOS). PCOS is caused by a combination of genetic and hormonal factors. As a consequence of the immune system being over stimulated by low progesterone levels in PCOS, estrogen levels rise, and antibodies proliferate. In autoimmunity, the systems responsible for the self-tolerance breakdown and immune response to self-components are induced. The induction of auto reactive cells characterizes autoimmune disease. Patients with PCOS often develop metabolic abnormalities, which are readily associated with lipid metabolism disorders, obesity, hypertension, diabetes, and other metabolic problems. Thus, PCOS patients have an elevated risk of atherosclerosis, which significantly raises their risk of cardiovascular disease. The study shows that cardio metabolic risk markers are much higher in women with PCOS, which means they are more likely to get lifestyle diseases like metabolic syndrome and heart disease.

Keywords: Polycystic ovarian Syndrome, metabolic syndrome, antinuclear antibodies, Diabetes mellitus, cardiovascular disease, Risk markers

INTRODUCTION

Polycystic ovarian syndrome (PCOS) is the most common endocrine condition affecting women[1]. This is a prevalent cause of menstrual abnormalities and infertility throughout the reproductive years. Genetic and hormonal variables have a significant role in PCOS etiology [2]. In women with polycystic ovary syndrome (PCOS), a deficiency in progesterone causes the immune system to become over stimulated, resulting in an increase in estrogen production and the development of auto antibodies [3]. It is hypothesized that auto antibodies may influence the long-term therapeutic care of these individuals because of the connection between PCOS and autoimmune antibodies such as ANA and anti-TPO, which have been identified in systemic lupus erythematosus and Hashimoto thyroiditis, respectively. There is a link between PCOS and autoimmune antibodies such as ANA and anti-TPO [4]. Consequently, the varying levels of auto antibodies in various PCOS patients allow us to open a new chapter in the study of molecular-level phenomena. It is possible that in the not-too-distant future, this may lead to the discovery of therapies for PCOS that are more efficient. Patients with PCOS are typically connected with obesity; most patients are predisposed to be fat throughout or even before puberty. Since obesity is a risk factor for cardiovascular disease (CVD), this inclination to be obese increases the prevalence of the disease [5].A decrease in high-density lipoprotein (HDL) and an increase in low-density lipoprotein (LDL) are the primary manifestations of abnormal lipid metabolism, which frequently occurs in PCOS patients and has a prevalence rate of approximately 70 percent. This condition is characterized by an abnormally high rate of CVD[6].The findings of the other research that has been conducted on the link between PCOS and cardiovascular disease are currently inconsistent. An important link was established between PCOS and Coronary Heart Disease (CHD)in the research published in 2016, yet there was no significant correlation detected between PCOS and cardiovascular progression. According to the findings of research carried out in 2017, people who had PCOS had a considerably greater chance of acquiring stroke when compared to those who did not have PCOS [7]. On the other hand, there was no significant relationship between PCOS and mortality from any cause. According to the findings of this meta-analysis, PCOS and non-PCOS patients have a significantly different risk of cardiovascular and cerebrovascular events, such as cardiovascular disease, myocardial infarction, ischemic heart disease, and stroke. These findings point to a connection between PCOS and the risk of CVD. However, this did not increase the mortality rate linked with the condition. The shared pathophysiologic processes have not been fully elucidated, and further research is necessary.

MATERIALS AND METHODS

The research included women with PCOS. One hundred eighty women were recruited and analyzed in total. Participants provided informed consent to participate after verbal and written explanations of the study's methodology and risks. This study was approved by the Institutional Ethics Committee of Government Medical College, Thiruvananthapuram Each participant in the experiment completed an informed consent form. Using glucose oxidase, blood glucose was determined enzymatically. The lipid profile was determined using an enzymatic semi-automatic analyzer and kits bought from ERBA diagnostics. The indirect immunofluorescence antibody approach was employed to detect ANA, with the fluorescence pattern findings presented. The chemilumine scence technique was utilized to determine anti – TPO levels.

RESULTS AND DISCUSSION

Table 1 describes the demographic variables and serum levels of biochemical parameters used to assess the cardiovascular risk in the test population. Table 2 provides demographic factors and serum biochemical parameter values for the control population. Various biochemical parameters are studied in women with and without PCOS. Comparing the general features of those with PCOS and those without PCOS reveals a significant difference. It has been reported that PCOS patients with metabolic syndrome have lower HDL levels. Numerous studies have shown that PCOS patients have slightly elevated triglyceride levels. Our study population also shows a similar pattern. According to additional studies on blood glucose levels, higher plasma glucose levels were associated with an

increased risk of developing PCOS due to hyperinsulinemia. Our study could not find a marked elevation of blood glucose. The likelihood of having PCOS is significantly impacted by body mass index. PCOS women frequently experience obesity and weight problems. In addition, obesity plays a significant role in the occurrence of PCOS. Females with PCOS have lower levels of HDL cholesterol. Both lean and obese PCOS women have a high amount of abdominal fat, and adipocytes significantly influence blood lipids. Consequently, lipid parametersare vital in PCOS. PCOS causes abnormally high levels of triglycerides. Triglycerides are converted into cholesterol esters due to the action of cholesterol ester proteins. This demonstrates that HDL containing triglycerides is more rapidly catabolized than VLDL containing cholesterol esters, converted to LDL. This demonstrates that HDL containing triglycerides is more rapidly catabolized than the conversion of VLDL containing cholesterol esters to LDL).Patients with PCOS consequently have lower HDL levels. Between PCOS patients and non-PCOS controls, there was a significant difference in Total Cholesterol and LDL levels. Triglycerides are slightly elevated in PCOS patients compared to non-PCOS patients, while LDL is significantly elevated. This finding may confirm previous research indicating that triglyceride levels are elevated in PCOS patients. The study showed a significant increase in Cardiometabolic risk markers such as LDL and TGL in PCOS women, indicating a higher risk of developing lifestyle diseases like obesity, metabolic syndrome, and heart disease.

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Table 1: Descriptive statistics of the test population

	Minimum	Maximum	Mean	Std. Deviation
AGE (Yrs)	21	36	25.58	2.975
HEIGHT (cm)	144	164	153.578	4.3395
WEIGHT (kg)	42	82	58.567	10.2749
BMI	19.4	32.9	24.706	3.4227
WAIST (cm)	64.5	96	82.889	8.2096
FBS (mg/dl)	75	126	87.256	11.6064
TG (mg/dl)	58	214	106.789	44.8138
TCL(mg/dl)	133	262	190.033	30.8750
HDL (mg/dl)	30	65	42.300	9.0124

LDL (mg/dl)	64	178	124.400	26.1804
VLDL (mg/dl)	12	43	21.600	8.9754

Table 2: Descriptive statistics of control population

	Minimum	Maximum	Mean	Std. Deviation
AGE (Yrs)	21	41	26.62	4.331
HEIGHT (cm)	144.0	164.0	154.756	4.5104
WEIGHT (kg)	42.0	82.0	58.900	9.6919
BMI	17.5	32.9	24.542	3.5444
WAIST (cm)	64.5	96.0	84.261	8.0288
FBS (mg/dl)	74.0	126.0	86.822	8.1758
TG (mg/dl)	57.0	182.0	106.267	21.3330
TCL (mg/dl)	151.0	249.0	185.989	15.8968
HDL (mg/dl)	29.0	66.0	47.622	6.3874
LDL (mg/dl)	87.0	165.0	109.944	15.3113
VLDL (mg/dl)	11.0	32.0	21.422	4.7593

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RESEARCH ARTICLE

Identification of Spreading Pattern of a Pandemic using Machine Learning, Deep Learning and Quantum Machine Learning

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ABSTRACT

Pandemic spread causes irreplaceable damage to the community Vindicate a wise elucidation by providing an exact spreading pattern of the pandemic in advance which will assist the authorities to take approved decision and prevent loss of lives. Existing Machine Learning and Deep Learning models forecasts the pandemic however the execution time might be delayed if the sample size grows widely. Quantum Machine learning models felicitates the process by piloting less computational time and accurate in prediction. This proposed investigation implemented multiple quantum machine learning models, to provide an improved insight about accuracy and gives precise awareness about preferring better model at the decisive context. Results are analyzed to identify the strengths and weaknesses of the outcomes. Precision, recall and f-measures metrics are implemented to prove dataset's quality **a**nd amalgamation. This study incorporates the proportional analysis of accuracy and speed scores of the Machine Learning (ML), Deep Learning (DL) and Quantum Machine Learning (QML) Models.

Keywords: Machine Learning, Deep Learning, Quantum Machine Learning Models, Evaluation Metrics.

INTRODUCTION

Technology era begins with the automation, which enables machines to think without any individual interference. AI technology is a goal oriented programs learned by experiences and allows acting upon the experiences. Machine Learning includes data parsing, learning the data and making right decisions based on the learned information. Deep Learning mimics the human brain and this procedure filters the information, extracting the data by analyzing the given information. After completion of the data retrieval, logical structure is generated to simulate with the drawn solutions. Multilayered architecture, called as neural network implements back propagation process to prove a best accuracy of the predictions. Quantum Machine Learning surpasses classical machine learning techniques, enormous

growth in data size creates a very big barriers when handling with classical machine learning techniques. Quantum machine learning handles complicated data i.e., vast quantity of data can be processed with high speed and very less bias. Quantum machine learning provides best and very speedy results because of the unique Characteristics like superposition and entanglement. Quantum entanglement involves exchanging quantum information. Superposition implements fluid quantum parallelism. Solutions can be arrived in much smaller number in steps. Quantum superposition is uncertainty, multiple states at the same time.

Related Work and Motivation

The existing situation urges the researchers, developers and epidemiologist to acquire thorough knowledge about the pandemic growth and technological models to approach these unpredicted issues. Henceforth we have listed seven technological models to approach these issues effectively. This study includes the detailed literature review of the modeling techniques to predict the pandemic well in advance. Researcher emphasizes the advantages of the modeling and its usages to have elaborated knowledge about the models and on which context which model is ideal for accurate prediction. From the above modeling survey, there are many investigations available to get clear knowledge about the knowledge gaps. Shim E, Tariq A, Chio W, Lee Y, contributed on "transmission potentials and severity of machine learning and deep learning, Tosepu R, Gunawzn J, Effendy D, S, Ahamed H, Lestari H, Contributed on "Covid -19 spreading identification using quantum neural networks", Tulis, Gil S, contributed on "Predicting the growth of the covid-19 pandemic using Convolutional neural network algorithms",

Design of the Study

Tan Q, Lee F, Wang X, contributed on "forecasting the pandemic using Hybrid quantum computing model". Most of the existing quantum computing models are based on singular learning model. This motivated the researcher to improve the accuracy to involve suitable quantum machine learning models such as, quantum-|Logistic regression, Quantum-Polynomial Regression and quantum K-nearest neighbor's models. The outcomes are ensembled to improve the accuracy. This study design proposes a new approach to find out the existing model's spreading pattern and also using quantum machine learning models. Machine Learning and Deep Learning algorithms were developed by feeding the Kaggle dataset repository is useful for data collaboration. Time series based real time dataset were collected and implemented. The risk of an existing pandemic threatens day by day by increasing continuously. Machine learning, Deep learning and Quantum Computing algorithms were implemented to identify the threat in earlier, and this solution provides,

a. Diagnosing the disease early
b. Tracking the contacts made by the patients,

Screening the resources

Artificial Intelligence

Traditional technologies are not supporting to predict the future threat. The severity of the disease transmission is arrested or identified by implementing artificial intelligence systems. Machine learning and deep learning Algorithms supports massive contribution towards preventing the disease threat.Artificial intelligence's scope increases tremendously, like AI in disease diagnosis, AI in disease outcome, Medicine identification, drug analysis [4].

Machine Learning Algorithms

Support Vector Machines

Labeled Learning algorithms are capable of performing regression and classification problems. Support Vector Machines works on multiple datasets and it provides an optimal solutions too. Functional equation of the support vector machine is,

U Boundary = $a_1X_{1j}+….a_mX_{mj}+a0>=1…..(1)$

L Boundary = $a_1X_{1j}+….a_mX_{mj}+a0 <=1…..(2)$

All Points =$(a_1X_{1j}+..a_mX_{mj}+a_0)\ y_j>=1...(3)$

Linear Regression

Linear Regression algorithm is a underneath performance to identify the correlation between dependent and independent variables. If the dependent variable increases gradually the independent also will increase. The functional equations of the linear equations are,

$Y = mX + b = Y = a_0 + a_1X$

Y – Dependent Var.

X – Independent Var.

a_0 – cut off

a_1 – Coefficient.

Decision Trees

Sequence of decision can be made using decision trees. There are two dissimilar categories of decision trees; they are Categorical trees and Continuous trees. Decision trees are structured with Root Node, Decision Node and Termination node.

Naive Bayes

Naïve Bayes is machine learning classification technique works on Bayes theorem. It has two important properties, Probabilities of hypothesis and probability of evidence.

$P(A/B) = P(B/A) * P(A) / P(B)$

'A' represents Hypothesis and 'B' represents Evidence. This Classifier works well in real time classification, multi class and text classification.

K- Means Nearest Neighbor

KNN is a very simplest algorithm, works as a classifier as well as regressor. Identifying Euclidian distance among class 'A' and 'B'. Distance between A and B represented as

$\sqrt{(X2 - X1)2 + (Y2 - Y1)2)^2}$

KNN is easy to implement, works well on the noisy dataset.

Deep Learning Algorithms

Multi Layer Perceptron

MultiLayer Perceptron generates set of outputs from the set of inputs. This neural network model is structured with neurons connected with each other. Hidden layer performs operations and meaningful computations. Output Layer, predictions and data feed to the layers from input layers in both feed forward method and back propagation methods.

Convolutional Neural Networks

Deep Learning analyses complex algorithms. ANN to train computers, it can also be trained and learn to classify data which recognizes images. CNN mainly focuses on object recognition, classifies images widely. Processing deals with task recognition, processing and localizations. Examples are self driving cars, NLP processing and speech recognition. Mathematical functional representation is given below,

$$dW = \sum_{m=0}^{m} \sum_{n=0}^{n} WdZ[m.n]$$

Where W - represents filters and dz[m,n] is a partial derivatives of the differential formulation [8].

Recurrent Neural Networks

Recurrent Neural Network efficiently handling ordered data or sequential data, RNN suits perfectly on machine learning tasks. Improves computational power and also works optimally when the data size increases. Financial data, video, audio, weather and time series data handling, voice recognition are the main applications. Feed Forward and Back Propagation networks provide a accurate predictions based on the actual values. Types of RNN, one to one, one to many, many to one and many to many networks [5].

Quantum Machine Learning Algorithms

Quantum Polynomial Regression

Quantum polynomial Regression analysis used to forecast the dependent variable and assessing its influences.

Cost function = 1/n $\sum_{i=1}^{n} (PV - EV)2$

Relationship among independent var. 'X' and the dependent var. 'Y', n denotes degrees of the expression. E(Y/X) is a non linear relationship. Polynomial Equation is,

$Y = b_0+b_1X_1+b_2X_2^2+\ldots\ldots+bnX_1^n$

Quantum K- Means Nearest Neighbor's Algorithm

KNN is a non parametric machine learning model. IT identifies the nearest neighbor point which is very much closest to the actual given point. Predictions and classifications are performed by grouping of similar individual data points. Classification works with discrete values and the regression works with continuous values, based on the memory based learning method. Pattern Recognition, Financial market prediction, data mining are the main applications of KNN[6].

Quantum Logistic Regression Algorithm

Logistic Regression, machine learning model calculates the probability of event occurs in a dichotomic nature(Y/N). This procedure is working on discrete values. Classification problems can be solved. There are three types of logistic regression model, they are, binary provides dichotomic nature of the outputs, multinomial regression provides multiple outcome and the ordinal provides orderly outcomes. Mathematical representation of the logistic regression is demoted as,

$h\emptyset$ (x) = $1/1+e^{-(ß_0+ß_1x)}$……..(1)

$h\emptyset$ (x) – outcome,

$ß_1$ – slope,

$ß_0$ – y – intercept,

X – Independent variable,

Y = $((ß_0+ß_1*x)$ + error Value……(2)

Quantum logistic regression incorporates machine learning parameters with an ansatz optimizer to extract the predictions.

DATASET ACQUISITION FROM VARIOUS RESOURCES

There are three approached followed to acquire the data,

- IoT Sensing
- People Centric Sensing
- Assorted Sensing

IoT sensor collects data from the physical environment. Sharing information from the cloud and from there it has been transmitted to the individual devices like Patient's System and phones. Real time data can be monitored and stored information can be retrieved at any time. People centric sensing collects data from the authorities. Day-wise covid-19 patient's datasets includes, date, and confirmed, deaths, recovered, active, new cases, new deaths, new recovered, death/100 cases, recovered/100 cases and no. of countries [12].

SPREADING PATTERN OF THE PANDEMIC

Many Existing Machine Learning and Deep Learning models to identify the spreading pattern are available in the existing literature. References are [32], [33], [34], [35]. In order to compare the nuances of the proposed model, few existing models from the Machine Learning and Deep Learning were coded and executed. They are as follows, Support vector machines(SVM), linear regression(LR), decision trees)DT), naïve Bayes(NB) and k-means nearest neighbors(KNN) algorithms, deep learning models, namely multilayer Perceptron, Convolutional neural networks and recurrent neural networks [11].

Machine Learning Model

Performance Analysis

Summarizing correct predictions and incorrect predictions of a classification is called confusion matrix. Row of a matrix represents predicted values and the column represents actual values. TP - True positives - correctly predicted of the pandemic prediction values. FP - False positive - incorrectly predicted of the pandemic prediction values. TN - True Negatives - correctly predicted no pandemic prediction values. FN - incorrectly predicted no pandemic prediction values [7].

- **Precision**

Precision is a ratio of all the positive predictions, precision formula,
Precision = True Positive/TruePositive +False Positive = 1/1+1=0.5

- **Recall**

Measure of accurately predicted the actual data. Recall formula,
Recall = TruePositive / TruePositive +False Negative = 1/1+8=0.11

- **F-Measure**

F-measure is a harmonic mean value of precision and recall. Formula,
F-Measure= 2 * pre.val * recall.val / pre.val + recall.val

- **Accuracy**

Extracting only the correctly predicted values from the total number of outcomes are called accuracy. Formula
Accuracy = True Positive + True negative /True Positive + True negative + Fal.pos + Fal.neg.
Accuracy = Total No. of Correctly predict ed /Total No. of predictions.

Overall Metrics for Machine Learning Model

From the above evaluation, K-means Nearest Neighbor's Algorithm gives 98% of exactness and 99% of completeness of the prediction. Accuracy score of KNN model is 79.8%. Execution time taken by this algorithm is 1.8ns and we found that this algorithm performs well when compared with other models.

Deep Learning Model

Multi Layer Perceptron is a trained model to predict the time series datasets. Positive predictions are aggregated to find out the accuracy of the model, MLP predicts high count of positive predictions when compared with other deep learning models. Multi Layer Perceptron provides exactness in predictions.

Overall ǀMetrics for Deep Learning Model

From the above evaluation, Multilayer Perceptron model gives 100% exactness, and 98% completeness of the model's prediction. Accuracy score of the model is 89.7 % and execution time of the model is 1.5ns. When compared with machine learning models deep learning model, i.e., MultiLayer Perceptron gives high accuracy in prediction.

METHODOLOGICAL ISSUES

Knowledge Gap

Computational time delay leads instability of the system; it degrades the performance and communication lacking to take decisions. To overcome computational time delay we have made a systematic analysis about the spreading pattern by implementing the machine learning (ML) and deep learning(DL) models to predict the spreading in a proficient way. Incorporate ensembling models to identify the model's performance. Large samples were collected from different resources. Execution times taken by the models are high when the data size grows higher. Machine learning models and Deep learning models outcomes are compared and concluded that these models execution time is high and then there are huge accuracy variations. Quantum computing initiation is mandatory at this crisis.

PROPOSED METHODOLOGY

Empowering quantum Computing

Quantum Computing is technology centered with quantum mechanics, computer science and information theory. Super position, entanglement and interference are the major properties of quantum computing. Quantum machine learning model gives high computational speed and less data Storage. This research includes quantum logistic regression, k-means nearest Neighbor and polynomial regression algorithms to prove the quantum quality. Quantum machine learning bits are represented as qubits, atoms are called qubits. Qubits are behaving like a wave as well as particle. A wave stores more data than particle. Wave distribution occupies more data. Angled brackets are denoted to define the qubits states,

- Superposition of two states,
  - Ground state |0>
  - Intermediary state |1>
  - Qubit state is $|\Psi\rangle = \alpha|0\rangle$ ß $|1\rangle$
- Qubit state = $|\alpha|^2 + |ß|^2 = 1$

Penny Lane and its Applications

Penny lane is a connection among standard computing and quantum computing. Penny lane connects Numpy, Tensorflow, and Pytorch libraries import quantum variational functions. Input layer, processing layer, variational layer, preprocessing layer and classification layer are the important steps involved in penny lane frameworks.[28] This investigation considers 23 parameters, for prediction distribution researcher, considered only three influencing parameters, Regions, cases and months are considered as influencing parameters [21]. Pandemic Spreading Pattern identification helps to accelerate innovations, stimulating research towards knowledge sharing. Critical Zones were targeted easily and enabling the first line responders to act upon the crisis. Technical guidance is highly demanded during the emergency situations. All the three models produce a same spreading pattern with different accuracy and execution time taken by the models.

Variational Quantum Machine Learning Algorithm

1. Start the process
2. Importing the necessary libraries (Penny lane, Numpy, matplotlib)
3. Training Data = 0.75 and Testing Data = 0.25
4. Creating a quantum device by initializing the qubit simulator
   a. Creating quantum circuit to Identify quantum layer(W):
5. If no. of qubits >= 2 then
   a. Entangling the last qubit with the first qubit.
6. Controlled NOT gate wires = no. of qubits -1, 0
   a. Extracting variational classifiers by providing the qml_circuit and parameters, parameter shifting
7. QNode derivation - Importing variational circuit classifiers with all parameters.
   a. Get the scores computed for this sample by the other classifiers

b. for j = 0 to no. of classes
8. Return loss function values / number of samples
9. Enumerating Qnodes // deifning Qnode circuit functions
   a. Defining classifier - labels , all parameters, qml classifiers and features):
   b. Scores = circuits + parameters + feature vectors
   c. Appending predicted lables
10. Return the expected Values along with Z axis
    a. def ine accuracy(labels, hard predictions): predicting hard predictions and return loss val.
11. Classical Pre/Post processing
    a. Calculating loss function = (predicted value –Expected value)
    b. Defining cost function, selecting data from the training dataset.
    c. Prediction = [quantum circuit(X, parameters) for x in X]
12. Defining optimizer [adam optimizer]
    a. train the variational quantum classifier, total iteration, defining batch size and training feature values.
13. Improving cost function to extract better prediction
14. Plotting the result graph to visualize the prediction.
15. Stop the process.

Overall Metrics for Quantum Machine Learning Models

From the above evaluation, quantum logistic regression classifier provides 100% exactness, 99% completeness in prediction and 89.9 % accuracy in correct predictions.
Execution time taken by this classifier is 0.95ns.

Proven Results Integration

From the above investigation, researcher proved that quantum computing execution time is 0.01ns. This means, it provides expected predictions within 0.01ns time. Accuracy is measured by calculating ratio between the observed predictions from the total number of predictions. We have collected 150 samples from the day wise dataset, country wise dataset and region wise dataset. From 150 samples almost 20% of the samples are eliminated because of the imbalanced dataset, from the 80% of the dataset researcher divided into two sets, 70% training set and 30% testing set. This research focuses time series real time dataset, so data growth is continuous in nature and the pickle file, size also increases. Ensembling models proved that quantum computing models excel in accuracy and excel in execution time. Ensembling performance is implemented to find out the weak predictors and strong predictors. Occasionally weak or wrongly predicted might be blocked as spotted regions. Region wise prediction also carried out to plot the critical regions and regions needs to be blocked, i.e., quarantine areas and screening the resources availability to address the patients' immediately. Authorizing quantum machine learning models proved that execution time taken by the quantum Logistic regression is very less when compared with other reputed models. The data storage is also very tiny in size accordingly. Error rate also monitored and controlled by providing balanced datasets. Quantum machine learning models predicts the pandemic exactly. This forecasting study gives knowledge about the critical regions which are going to affect or in a danger zone are displayed clearly and the preventive measures can be carried out well in advance.

CONCLUSION

Pandemic threatens mankind and causes inimitable harm to the society. Day wise covid-19 cases, country wise cases and Region wise cases datasets are analyzed and interpreted to extract the optimization and simulation of the quantum machine learning models. Quantum variational algorithms are the important deployment to address these issues accurately. Taking approved decision at the right time by implementing time series real time dataset are highly Existing machine learning models, deep learning models performances are compared and integrated to find out the weak learners and the strong learners. Positive predictions and the negative predictions are classified and

evaluated based on the precision score, recall score and the f-measure scores of the models. Error rate is 0.3 %. Almost 93 % of positive predictions and only 3% of negative predictions are identified. Quantum machine learning reduces no. of epochs taken by the model and hence it improves the speed. Quantum processing (QPU) unit will be utilized efficiently and bottleneck during the interferences can be minimized. Possible using these AI technologies. This investigation implemented quantum computing models to predict the pandemic in a very short computational time. This research ensures and controlling the future spread and providing knowledge and guidance about the covid-19 spread professionally.

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Table.1. Literature Review [1]

S. No	Models Description	Applications	Implementation Ratio
1.	Compartmental Models	SIR Predictions	61.04%
2.	Statistical Models	Parametric Distribution Fitting	31.77%
3.	Artificial Intelligence Models (Machine Learning)	Computational Predictions	78.11%
4.	Bayesian Approach Models	Handles small no. of datasets	54.02%
5.	Network models	Estimates Longer period Parameters	42.10%
6.	Agent Based Models	Simulation Techniques	13.2%
7.	Hybrid Models	Decomposing the variations	17.4%
8.	Deep Neural Network Models	High Accuracy predictions	60.8%
9.	Quantum Computing Models	High speed Computational Predictions	24.02%
10.	Mem Computing	Optimization analysis	1.4%

Table. 2. Day Wise Covid-19 Patient's Details

Date	Confirmed	Deaths	Recovered	Active	New Cases	New Deaths	New Recovered	Deaths/ 100 cases	Recovered/ 100 Cases	No.of countries
1/6/2021	555	17	28	510	0	0	0	3.06	5.05	60.71
2/6/2021	654	18	30	606	99	1	2	2.75	4.59	60
3/6/2021	941	26	36	879	287	8	6	2.76	3.83	72.22
4/6/2021	1434	42	39	1353	493	16	3	2.93	2.72	107.69
5/6/2021	2118	56	52	2010	684	14	13	2.64	2.46	107.69
6/6/2021	2927	82	61	2784	809	26	9	2.8	2.08	134.43

7/6/2021	5578	131	107	5340	2651	49	46	2.35	1.92	122.43
8/6/2021	6166	133	125	5908	588	2	18	2.16	2.03	106.4

Table. 3. Country wise Covid-19 cases dataset Details [25]

Country/ Region	Confirmed Deaths	Recovered	Active	New Cases	New Deaths	New Recovered	Deaths/100 cases	Confirmed/ 100 cases	Confirmed last week	1 week change	1 week % increase	WHO Regions
Gabon	7189	49	4682	2458	205	0	219	Gabon	7189	49	4682	2458
Gambia	326	8	66	252	49	2	6	Gambia	326	8	66	252
Georgia	1137	16	922	199	6	0	2	Georgia	1137	16	922	199
Germany	207112	9125	190314	7673	445	1	259	Germany	207112	9125	190314	7673
Ghana	33624	168	29801	3655	655	0	307	Ghana	33624	168	29801	3655
Greece	4227	202	1374	2651	34	0	0	Greece	4227	202	1374	2651
Greenland	14	0	13	1	1	0	0	Greenland	14	0	13	1
Grenada	23	0	23	0	0	0	0	Grenada	23	0	23	0
Guatemala	45309	1761	32455	11093	256	27	843	Guatemala	45309	1761	32455	11093
Guinea	7055	45	6257	753	47	2	105	Guinea	7055	45	6257	753
Guinea-Bissau	1954	26	803	1125	0	0	0	Guinea-Bissau	1954	26	803	1125

Table. 4. Tamil Nadu Region wise Covid-19 cases dataset Details [26]

Region Names	Month	Days-15th Aug	23rd Aug	31st-Aug	Infected	Days-15th Aug	23rd Aug	31st-Aug	Deceased	Days-15th Aug	23rd Aug	31st-Aug	Recovered
Vellore	July	2038	1925	2262	6225	43	45	42	130	290	380	282	952
Salem	July	2019	1890	1879	5788	34	50	47	131	281	298	416	995
Madurai	July	2041	1882	2088	6011	37	33	43	113	306	216	305	827
Chennai	July	1999	1919	1987	5905	42	41	32	115	409	301	280	990
Kanyakumari	July	2048	1824	1805	5677	46	55	54	155	352	401	309	1062
Trichy	July	2015	1692	1805	5512	51	71	38	160	369	347	306	1022
Thanjavur	July	1974	1901	2136	6011	45	46	60	151	320	252	317	889
Coimbatore	July	2041	1455	1971	5467	47	42	59	148	274	336	298	908
Thirunalvelli	July	1947	2183	2067	6197	42	38	32	112	301	236	511	1048
Puducherry	July	1300	1893	2006	5199	35	45	42	122	340	307	332	979
Mahabalipuram	July	1054	2221	2082	5357	45	42	35	122	243	373	321	937
Kochi	July	1520	1521	1997	5038	38	42	41	121	149	319	327	795
Kanchipuram	July	2033	2023	2146	6202	37	57	44	138	288	283	331	902
Tirupattur	August	1875	2050	1806	5731	10	23	31	64	190	200	310	700
Arakonam	August	1545	1775	1889	5209	20	21	27	68	287	210	322	819
Gudiyatham	August	1735	1755	1996	5486	19	20	28	67	270	254	321	845
Vaniyambadi	August	1665	2042	1833	5540	30	24	22	76	240	327	342	909
Ambur	August	1990	1597	1885	5472	22	19	30	71	320	256	432	1008

Table 5: Overall Metrics for Machine Learning Model

Algorithm	SVM	LR	DT	NB	KNN
Precision	1	1	0.7	0.933	**1**
Recall	0.79	0.643	1	0.65	**0.98**
F-Measure	0.883	0.821	0.85	0.79	**0.99**
Accuracy	75	74	72.6	78.9	**79.8**
Speed	3.1ns	2.6ns	3.7ns	2.1ns	**1.8ns**

Table 6: Overall ǀMetrics for Deep Learning Model

Algorithm	MLP	CNN	RNN
Precision	**1**	0.89	0.89
Recall	**0.98**	0.86	0.95
F-Measure	**0.99**	0.87	0.92
Accuracy	**89.7**	87.9	85.6
Speed	**1.5ns**	2.1ns	1.8ns

Table 7: Overall Metrics for Quantum Machine Learning Models

Algorithm	QML-PR	QML- KNN	QML-LR
Precision	0.9	1	**1**
Recall	0.98	0.98	**0.99**
F-Measure	0.94	0.99	**0.99**
Accuracy	89.2	87.3	**84.9**
Speed	1.2ns	0.99ns	**0.95ns**

Table 8: Proven Results Integration

Algorithms	ML	DL	QML
Accuracy	76.06	**89.7**	**86.8**
Speed	0.6s	0.45s	**0.01s**

Table9. Overall Predictive model's assessments

Prediction Models	SVM	LR	DT	NB	KNN	MLP	CNN	RNN	Q-PR	Q-KNN	Q-LR	En.Sem
Accuracy	75	74	72.6	78.9	79.8	89.7	87.9	85.6	89.2	87.3	84.9	89.7
Speed	3.1ns	2.6ns	3.7ns	2.1ns	1.8ns	1.5ns	2.1ns	1.8ns	1.2ns	0.99ns	0.95ns	1.5ns

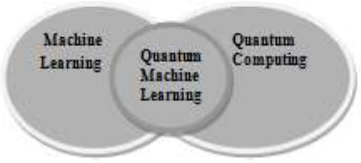

Fig.1. QML Hybridization

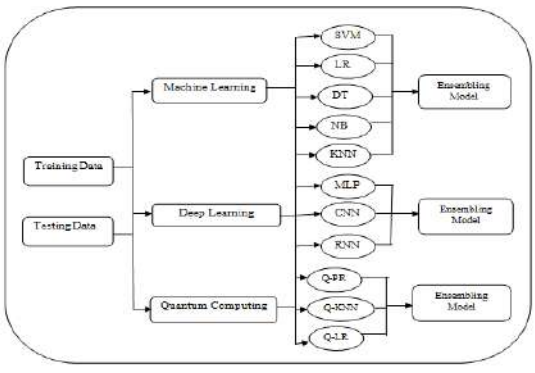

Fig. 2. Architecture of the study

Fig. 3. Spreading Pattern using ML Algorithms

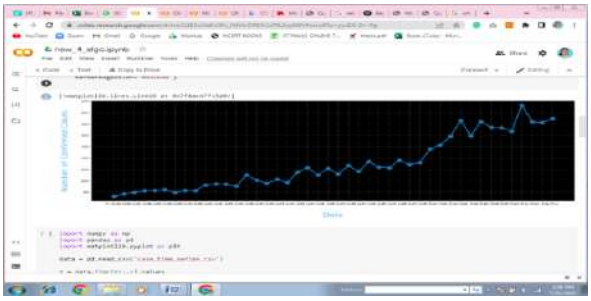

Fig. 4. Spreading Pattern using DL Algorithms

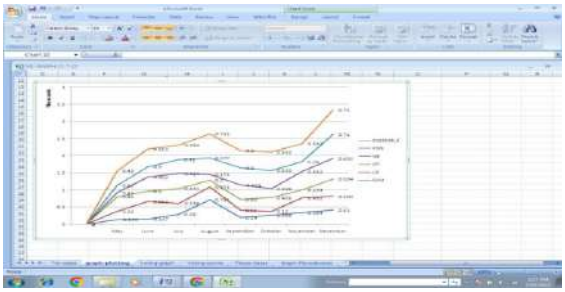

Fig. 5. Ensembling Machine Learning Models.

Fig.6. Ensembling Deep Learning Models

Fig. 7. Penny Lane Installation

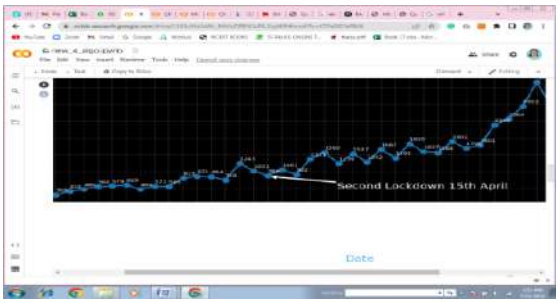

Fig. 8. Spreading Pattern using QML Algorithms

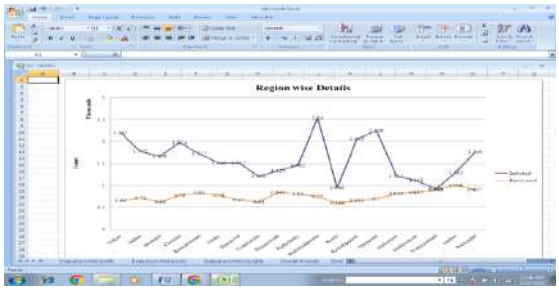

Fig. 9. Region wise Plotting

Fig.10. Overall Model Accuracy and Execution time scores

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RESEARCH ARTICLE

Effect of Smartphone Overuse on Median Nerve Conduction Velocity in Physiotherapy Students

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ABSTRACT

We are in the twenty-first century, also known as the information age. The use of smart phones has grown tremendously in recent years, which can affect the physiological and psychological changes. Smartphone users frequently experience these symptoms, including headaches, hand tremors, and finger numbness etc. There is a need to investigate the relationship between smartphone usage median nerve conduction velocity because there is a paucity of literature regarding the relationship between smart phone addiction and its effect on the musculoskeletal system and peripheral nerves. Smartphone users were assessed by smart phone addiction scale- short version (SAS-SV) and allocated in two groups according to SAS-SV score. Total 100 students were taken and divided into 2 groups. Group A which had score less than 84 and group B which had more than 84 score. Pre-test procedure was done and after that Motor and sensory nerve conduction velocity was measured in dominant hand. There was significant difference in sensory nerve conduction velocity in between group p value is <0.05. In between the groups there is no changes motor nerve conduction velocity but there is decrease in sensory nerve conduction velocity.

Keywords: Smartphone addiction scale short version, Motor nerve conduction velocity, sensory nerve conduction velocity

INTRODUCTION

We are in the twenty-first century, also known as the technology world.[1] One of the most essential tools that helps individuals interact with others is the smartphone, which provides an easy and quick way to communicate. The use of smartphones has grown tremendously in recent years. Thailand ranked top in the world in terms of smartphone use in 2020, with 3.5 billion smartphone users.[2] "Produce pleasure, provide escape from emotional or physical

discomfort, and are characterised by powerlessness (i.e., an inability to control the behaviour) and unmanageability (i.e., significant negative consequences resulting from the behaviour"), according to the definition of behavioural addictions. Smartphone addiction is correlated with the internet addiction and which can lead to behavioural addiction.[3]During Covid-19, Isha Akulwar-Tajane *et al.* conducted research in 2021 on the Impact of Excessive Screen Time and the Mediating Effect of Physical Exercise on Sleep in Physiotherapy Students. They found that during the lockdown, 94.7 % of students' screen time increased. On a daily basis, 43.3% of student participants spent more than 6 hours on digital devices. During the lockdown, 73.3% of the people agreed that screen time had an impact on their sleeping patterns. 64% of students had trouble sleeping. Excessive screen use has harmed the sleep quality of 52% of respondents. 65.3% of students participate in physical activities on a regular basis, with 65.27% reporting less sleeping problems.[4] In 1791, Galvani's discovered that the nerves were a good conductor of electricity and his observation revealed that there is a relationship between electrical stimulation of nerve and muscle contraction. Helmholtz measured the conduction velocity of a nerve in a frog in 1850 by mechanically monitoring the muscle twitch. Hermann (1878) stimulated the brachial plexus in the axilla and recorded the muscular action potential on the forearm's surface, which he called action current.

Remak (1858) discovered that stimulating the places where the nerves enter the muscle was simple. Nerve injury and dysfunction are assessed using a nerve conduction velocity (NCV) test. The procedure, also known as a nerve conduction study, assesses the speed with which electrical signals pass through your peripheral nerves. In the NCV there are motor and sensory nerve conduction velocity. Motor conduction can be measured orthodromically and sensory conduction can be measured orthodromically or antidromically. There are physiological and technical variables which affects the nerve conduction velocity. Physiological variables are age, upper limb vs lower limb and temperature.[5,6] Median nerve is a sensory and motor nerve which derived from $C_5$to T_1 roots via medial and lateral cords of brachial plexus. It supplies most forearm flexors and thenar muscles and provides sensory innervation to the lateral aspects of palm and dorsal surface of terminal phalanges along with the palmar surface of thumb, index, middle, and half of ring fingers.[5] Smartphone addiction scale short version (SAS-SV) is for smartphone addiction. It consists of 6 factors following are the 6 factors: life disturbance, positive anticipation, withdrawal, cyberspace-oriented relationship overuse and tolerance. Total 33 items with a 6 points scale in which 1 is strongly disagree and 6 is strongly agree. ICC score of the SAS-SV was 0.967 which indicate good reliability.[7]

Need of Study

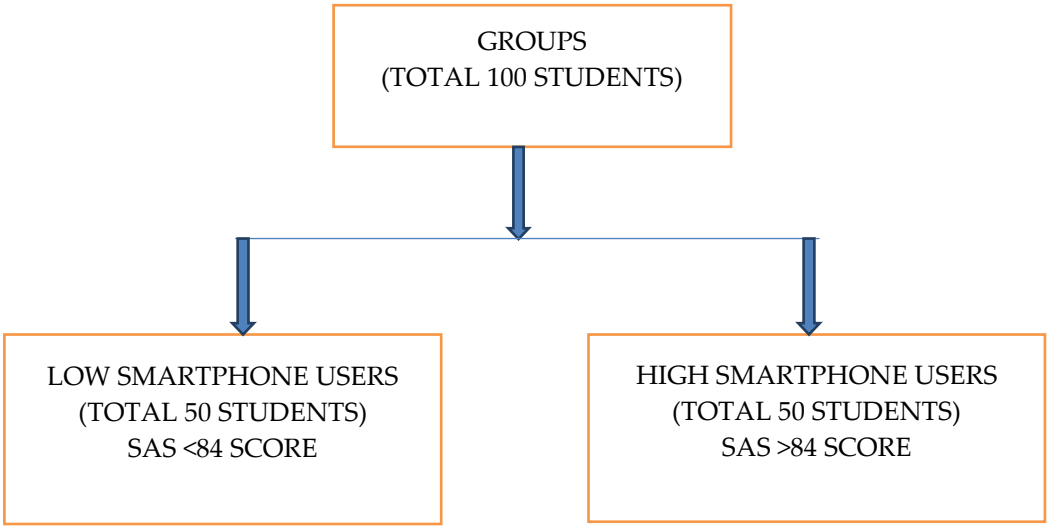
There is increased incidence of smartphone user's day by day due to online lectures, increased computer work, gaming addiction etc. There is low evidence of motor and sensory nerve conduction velocity of median nerve in such population.

MATERIALS AND METHODOLOGY

Data collection was done at Physiotherapy Institute, Ahmedabad, Gujarat. Total 100 students were randomly allocated into group A and group B and observation study was done. Duration of Study was 6 months. Assessment form, Consent form, Worksheet (Smartphone addiction scale, Stationary, Plinth, Infrared thermometer, NCV apparatus, Ultrasonic gel, Micro pore tape, spirit, saline solution, cotton were used as a material. Inclusion criteria were(1)18 to 25 years of age of students, (2) Subjects who are using phones continuous for chat conversation, gaming and holding cell phones for prolonged period of time (30 min to 4 hours), (3)students with smart phone addiction scores of ≥84 was considered high smartphone users, and the students with smart phone addiction scores < 84 was considered as low smartphone users and Exclusion criteria were(1)Any neurological pathology of dominant upper extremity (2)Previous contracture of dominant upper extremity, (3)Any orthopaedic pathology of dominant upper limb extremity. Outcome measures were Motor nerve conduction velocity (MNCV) and Sensory nerve conduction velocity (SNCV).

METHODOLOGY

Ethical approval was done and after that procedure was started. The subjects fulfilling the inclusion criteria was selected and informed regarding the protocol of the study. Prior to the procedure all subject will considered for demographic data on age, height, weight, gender, dominance (preferred hand for phone usage) and occupation. The subjects divided into two groups on the basis of level of usage assessed by smartphone addiction scale.



PROCEDURE

The test protocol was explained to the subject. Consent form was signed from all the students to collect the requisite data. Skin temperature (˚F) was measured through infrared thermometer. Room temperature was maintained at 21 to 23˚C. Height in centimetre and Weight in kilogram was taken. Smartphone addiction scale short version was taken. Motor and sensory nerve conduction velocity of median nerve was performed on dominant upper extremity.

NERVE CONDUCTION VELOCITY

Nerve conduction velocity of median nerve was performed on dominant upper extremity. As per protocol, the body parts were cleansed with spirit before nerve conduction velocity test. The ground electrode, recording surface electrodes and stimulator was used to assess the motor nerve conduction velocity and the ground electrode, recording ring electrode and stimulator was used for recording the sensory nerve conduction velocity. The conduction distance will be measured by using flexible measuring tape and recorded in centimetres. Nerve conduction velocity (m/sec) will be measured by using following formula.

Motor nerve conduction velocity (MNCV) =D/PL-DL
Sensory nerve conduction velocity (SNCV) =D/L
Where: D= distance in cm, PL= proximal latency in milli seconds, DL= distal latency in milli second and L= latency in ms.

Median Motor Nerve Conduction

The patient position was supine lying with arm abduction approximately to 45˚ with elbow extension and forearm supination. The recording electrode was placed close to the motor point of abductor pollicis brevis and reference electrode was distal to it. A supramaximal stimulus was given at wrist (3cm proximal to the distal crease) and at

elbow (medial to the tendon of biceps). The conduction distance between the two stimulated points was measured by using measuring tape.[5,6]

Median Sensory Nerve Conduction

Sensory conduction velocity of median nerve was measured by antidromic stimulation. The patient position was same as for the median motor nerve conduction. The recording was made from ring electrode at interphalangeal joint of index finger and stimulation was given at wrist. The conduction distance between the recording and stimulating electrode will measured by using measuring tape.[5,6] Statistical analysis was performed using SPSS version 25. Total 100 subjects were taken for diagnosis of median nerve conduction. In this study group A was Low smart phone users according to smart phone addiction scale <84 and group B was high smart phone user according to smart phone addiction >84. Both the groups were similar in age and gender. The study analysis was Motor and Sensory Nerve conduction velocity of High and Low smart phone users. Within group effects were explored by using paired t-test and Between group effects were explored by using independent t test. In the results data shows value of mean, standard deviation, t value and p value. Statistical significance was set at $p<0.05$.

RESULTS

Total 100 subjects were taken in the study. Out of them 13 were male subjects and 87 subjects were female. To assess the changes in motor and sensory nerve conduction velocity in low and high smartphone users within group (dominant hand and non-dominant hand). Paired sample t test was used. There was no significant difference in the motor nerve conduction velocity of dominant hand in low and high smartphone users. and significant difference in sensory nerve conduction velocity p value 0.001 high and low smartphone users. According to kimura median motor nerve conduction velocity is 58.52±3.76 and sensory nerve conduction velocity is 56.2±5.8. There was significant difference in sensory nerve conduction velocity between high and low smartphone users P value was <0.001.

DISCUSSION

The purpose of this study is to evaluate and compare the sensory and motor nerve conduction velocity in low and high smartphone users. As result shows there was a significant difference in the sensory nerve conduction velocity in between the high and low smartphone users. Seong-Yeol el al, observed that working on smartphone for long period of time promotes the repetitive use of certain muscle resulting in muscle fiber injury and cumulative damage due to acute trauma, which most occurs in neck and shoulders. This induced damage caused forward head posture and either referred to muscular pain both arms and wrists because of physical factors, including a reduced number of contracting muscle fibers and decreased motor-unit firing rates and changes in muscle fibre type.[8] Samman *et al* reported that repetitive movement may be associated with repetitive micro trauma to the musculoskeletal structure. This condition caused by an alteration of length tension relationship in the muscles.[9] According to kimura median motor nerve conduction velocity is 58.52±3.76 and sensory nerve conduction velocity is 56.2±5.8. There is no statistical difference in the median motor nerve conduction velocity of high and low smartphone users. Sensory nerve conduction velocity is decreased in the high smartphone users compared to low smartphone users. The mean value of high smartphone users SNCV is 49.84 m/s of and low smartphone users SNCV is 59.16 m/s.[5,6] Inal *et al* showed that there was enlargement of median nerve in the people who frequently use smartphone which is associated with carpal tunnel syndrome resulting in thickening of flexor pollicis longus tendon at both the mid thenar region and the first metacarpophalangeal joint in high smartphone users.[10] In this research there is negative weak correlation between duration of smartphone usage and sensory nerve conduction velocity. There is decrease in the sensory nerve conduction velocity of the high smartphone users. In the smartphone users there is repetitive flexion and extension of the wrist which cause the compression in the carpal tunnel leads to mechanical disruption of the axon and myelin of the nerve. Dyck *et al* discovered that due to nerve compression endonerial fluid, axoplasm, and myelin were displaced away from pressured sections of the nerve. There was an increase in distance between Ranvier nodes and distortions of myelin lamella at the compression point, causing direct interruption of saltatory

conduction or interfering with normal axoplasmic transport.[11]As increases myelin thickness internodal capacitance and conduction decreases [5]. The known A fibres were divided into α, β, γ and δ in order of decreasing conduction velocity in Erlanger and Gasser's investigation [12]. This may be one of the results for decreased sensory nerve conduction velocity of median nerve in high smartphone users.

CONCLUSION

Result shows that in between the groups there is no changes in motor nerve conduction velocity but there is decrease in sensory nerve conduction velocity in the dominant hand of the High smartphone users.

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Table 1. Motor nerve conduction velocity values of dominant hand

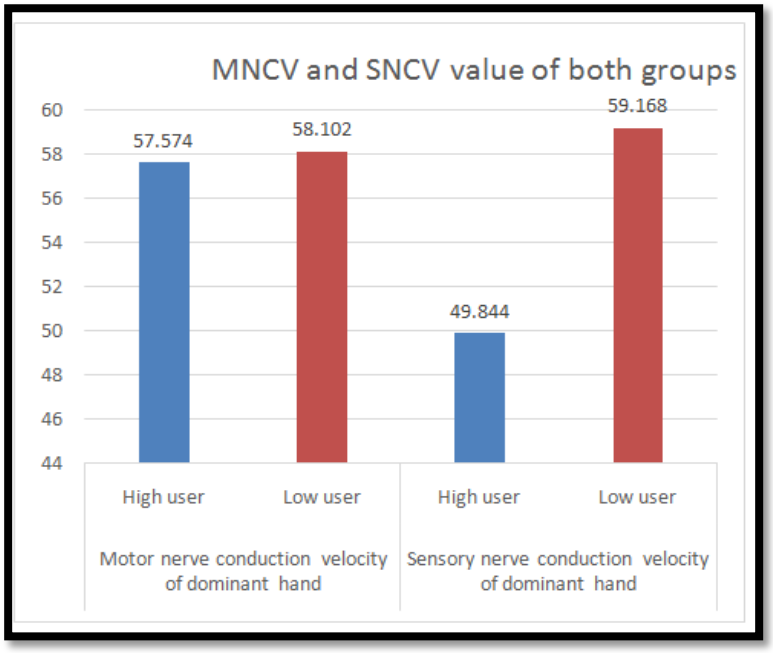
MNCV	Mean	SD	t value	p value
Low user	58.102	3.087	0.922	0.361
High user	57.573	3.454	-0.258	0.797

Table 2. Sensory nerve conduction velocity values of dominant hand

SNCV	Mean	SD	t value	p value
Low user	59.168	2.693	7.792	0.001
High user	49.843	3.723	-12.071	0.001

Table 3. Difference in between the groups

Outcome	Group A	Group B	p Value
Motor nerve conduction velocity of dominant hand	58.102	57.574	0.421
Sensory nerve conduction velocity of dominant hand	59.168	49.844	0.001



Graph 1. Difference of MNCV and SNCV in between the groups

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RESEARCH ARTICLE

Leakage Current Reduction in Static CMOS VLSI Circuits using Back Search Algorithm

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ABSTRACT

The technical evolution of shrinking the transistor size and reduction of supply/threshold voltage significantly increase the sub-threshold leakage current in the circuit. The sub-threshold leakage current is significantly higher than the other leakage current components present in the circuits. The disproportionate leakage current will reduce the life span of the device and it will lead to potential reliability problems. Temperature instability caused by this leakage current will produce premature failure in Very Large Scale Integration(VLSI) circuits. The improved input vector control method is used to diminish the leakage current in the circuit. This method can be further efficiently improved by using Back-Search algorithm. This algorithm is used to reduce the searching time for finding the suitable Minimum Leakage Vector (MLV) inputs. This method does not necessitate any modification in process technology hence it can be implemented easily. The proposed input vector control method can optimize the device performance and power dissipation. The circuit delay degradation and leakage current is further reduced by integrating the input vector control method and back search algorithm. The test results of various circuits show the feasibility and effectiveness of the proposed combination method.

Keywords: Static CMOS; Leakage Current; sub-threshold; input vector control method; Back Search algorithm.

INTRODUCTION

For the last two decades, consumer demand the reduction in size of the electronic devices and increasing the functionality of the devices. The electronic industry is constantly striving hard to reduce the size of the chip and increase the functionality of the device. The design engineers are facing anxious design issues for enhancing the device performance and achieve greater packing density of the chip [1]. The power factor is playing major role in the electronic devices because most of the devices are operating wirelessly and battery operated device. However, scaling of supply voltage is accompanied by threshold voltage scaling to achieve a large drive current and achieve boost performance. While in sub-threshold leakage current voltage scaling is significantly increment which causes the leakage in power [2]. A single chip contains millions of CMOS transistor which consumes power due to the leakage current in the idle condition [3]. Selvam *et al* [4] reviewed different leakage reduction techniques for CMOS circuits. They identified that the technology scaling is being done along with the increase in the count of transistors in VLSI circuits, there is a high risk of leakage power dissipation and require innovative techniques to reduce leakage power consumption. Banu *et al* [5] proposed various techniques for decreasing the leakage power in deep submicron CMOS circuits. Kassa *et al* [6] proposed a new leakage current reduction approach in cmos based circuit designing.

They proposed FORTRON (FORced stack sleep TRANsistor), which decreases the leakage power efficiency in the CMOS-based circuit outline in VLSI domain. This approach reduces leakage current in both active as well as standby modes of operation. Mohammadian *et al* [7] proposed a new technique for simultaneous reduction of the delay and leakage current in digital circuits. Maryan *et al* [8] proposed a new circuit-level technique for leakage and short-circuit power reduction of static logic gates in 22-nm CMOS Technology. Munirathnam *et al* [9] stated that downsizing of CMOS innovation improved the speed and simultaneously leakage currents are left over as struggle [10]. Islam *et al* [11] proposes a time-domain leakage current measurement circuit that uses an external-reference-free current-to-time conversion. Mukherjee *et al* [12] proposed a new MOSFET structure for reduction of reverse bias PN junction leakage current. Priya *et al* [13] propose a design and optimization of floating point division and square root using minimal device latency. Korah and vijayan [14] propose a power gating technique to reduces static power consumption but it increases the delay of the logic cells badly in deep submicron CMOS circuits and the performance is besmirched to a great extent. Harikrishna *et al* [15] stated that the short channel effects cause leakage current to flow through the transistor which increases static power dissipation of the circuits. Aforementioned literature reviews reveal that the threshold variation and the leakage current reduction is not a straight forward. The numerous approaches are proposed by various researchers to solve this design issues. The low power VLSI circuit design faces the challenging issues of power dissipation as transistor count doubles for every couple of years. In this paper we proposed an improved input vector control method integrated with back search algorithm to solve leakage current problems in CMOS VLSI circuits.

Threshold Voltage Variation

The fig.1 shows two types of transistors; one is a Normal type and another one is an bolded transistors. The transistors that are bolded have the high threshold voltages and the transistors that are not bolded have lower threshold voltages, so in this method the rail power is highly reduced. The threshold voltage for the bolded transistor is usually greater than the supply voltage, so it requires two types of power supply; one for the normal transistors and another for the high threshold voltage transistors. Because of this reason, this creates difficulties in order to reduce the leakage current of the application.

SUPPLY VOLTAGE GATING

The Fig. 1 implements the inverter logic with the supply voltage gating. The output will be low when the input is high and the output will high only when the input is low. The lower threshold transistor will gets conducting only when the high threshold transistors made on. The high threshold transistors will have made ON only when the sleep signal is activated. When the sleep signal has low value, the high threshold p- and n- type transistor will be in OFF state, so there will not be any rail current between Vdd and ground.

Minimum Leakage Vector

The first step to generate the leakage computing network is the addition of a decoder for each gate. The Leakage Computing Network (LCN) structure can be generated by means of four steps like decoder, counter, multiplier, adder and comparator. The comparator is used to compare the leakage values between the standard values with the newly computed leakage values. If comparator produces 1 as a result; then it shows that new leakage value is less than the standard reference leakage value and this new input is taken into consideration. If the comparator produces 0 as a result; then it shows that the computed leakage value has greater leakage value than the standard reference value and the new input is dropped. So by the value of the comparator the input is selected and this input is called as Minimum Leakage Vector (MLV), because this is the input that produces minimum leakage among the other inputs. Fig.2 shows a 2-to-4 decoder and D_{ij}^{k} values represent the input combinations ij of $gate_k$.

Consider a 2 input gate and let leakage (Zj) be the leakage current of the j^{th} gate of a circuit under the input vector combination Zj. The leakage (Zj) can be written as sum of up to 2^n terms, where n is the number of inputs of the gate. For two-input NAND gate, it is given by,

$$\text{Leakage } (Zj) = Zj_1\, Zj_0\, L_{00} + Zj_1\, Zj_0\, L_{01} + Zj_1\, Zj_0\, L_{10} + Zj_1\, Zj_0\, L_{11} \qquad (4.1)$$

Where L_{pq} is denoted as leakage current of the gate when $Zj_1 = p$ and $Zj_0 = q$. the cost function can be directly implemented in the LCN by using adders and multiplexers. This can be decreased by the following approach. In a straight forward LCN realization, the following sum is computed:

$$\text{Leakage } (Z_i) + \text{Leakage } (Zj) = (Zi_1\, Zi_0\, L_{00} + Zi_1\, Zi_0\, L_{01} + Zi_1\, Zi_0\, L_{10} + Zi_1\, Zi_0\, L_{11}) + (Zj_1\, Zj_0\, L_{00} + Zj_1\, Zj_0\, L_{01} + Zj_1\, Zj_0\, L_{10} + Zj_1 Zj_0\, L_{11})$$

It requires m(n-1) single bit adders. The LCN size can be reduced as follows:

$$\text{Leakage } (Zi) + \text{Leakage } (Zj) = (Zi_1\, Zi_0 + Zj_1\, Zj_0)\, L_{00} + (Zi_1\, Zi_0 + Zj_1\, Zj_0)\, L_{01} + (Zi_1\, Zi_0 + Zj_1\, Zj_0)\, L_{10} + (Zi_1\, Zi_0 + Zj_1\, Zj_0)\, L$$

To compute a total leakage, we use a decoder for each gate. Fig.3 Contribution of all gates of type k to the total leakage. The output of the decoder is given to the counter, so that the counter counts the gates that have same type of inputs. For 2 input gates, a 2-to-4 decoder is connected to the gates because it has four different types of leakage currents. The leakage current is multiplied to the respective counter value and the outputs from all multiplier units are added and that gives the total leakage of the circuit. Finally multiplexers are added to the inputs to shift in the MLV when the circuit enters the sleep / idle mode. The multiplexer uses sleep signal as its selection line and it selects the input between minimum leakage vector and the present input. Finally, the leakage current of all the gates are added to get the total leakage current and the aim is to get the total leakage current less than the specified value C. This can be done by comparing the total of all leakage currents to the specified leakage value C as shown in the Fig. 4. If we get the true value in the output then the applied input gives the minimum leakage vector. Note that the decoder is added only to find the leakage current; it will not be added to the final circuit.

The final circuit has only the multiplexers with the original circuit and the multiplexers is used to select the type of inputs whether original vector or the MLV vector. If the comparator produces 0 as a result; then it shows that the computed leakage value has greater leakage value than the standard reference value and the new input is dropped. So by the value of the comparator the input is selected and this input is called as Minimum Leakage Vector (MLV), because this is the input that produces minimum leakage among the other inputs. One input of the multiplexer is the normal input and the other input is the minimum leakage input vector, so the selection line called as sleep signal can make the selection between these signals. Whenever the sleep signal is activated the minimum leakage vector gets forced into the circuit as input else the normal input is forced into the circuit as the input. The final circuit implementation is shown below fig.5. The inputs IN1 and IN2 are selected and are forced to the circuit if and only if the sleep signal is not activated i.e., it should have zero as its signal value. The MLV (Minimum Leakage Values) will be selected as input to the circuit if and only if the sleep signal is activated. The switch between the input values will also consume some power and it can be reduced if the sleep period is long enough.

Consider any model circuit to implement this method to compute leakage current of that circuit. Fig. 6 and 7 are the two model circuits considered here. To this circuit, the first step is to add a decoder to every gate, since two input gates are used as a model circuit, a 2-to-4 decoder should be used. The second step is to add a counter to the output of the decoder; which counts the type of input that the gate has. After counting the type of data's the respective leakage currents are multiplied to this counter value. Then this leakage value is compared with the standard leakage value of the circuit and if it is less than the standard value then this new input corresponding to this minimum leakage is chosen. If it is not less than the standard reference value, then the new input combination is dropped and the old input pattern is considered as the input that produces the minimum leakage current.

PROPOSED METHODOLOGY

In this paper, we propose a Modified input vector control and back search algorithm to reduce the leakage current reduction as well as power dissipation in the circuit. The minimized input vector input is identified and it was integrated with back search algorithm to formulate the optimal input to balance the transaction between performance and power. The flow chart for the proposed method is shown in figure Fig. 8.

INPUT VECTOR GENERATION

The optimized input combination of the circuit produces a minimum leakage current. Different input combinations will have different leakage currents correspondingly. So the search should be made among all possible input combinations. Since the entire input combinations are required to achieve the minimum leakage, the search time will be large. The search time can be reduced if and only if the number of inputs is less, because for n input circuit the number of input combinations will be 2^n. So, the circuit will have 2^n different leakage currents. If the value of n is large then the value of 2^n different leakage currents for different input combinations, then the search time will be more.

BACK SEARCH ALGORITHM

In Back - search algorithm the assignment of input values to the gates starts from the last stage i.e., the input to the last stage output. Then this input will be the output of the previous stage. Now the input to the last but one stage can be assigned such that it should produce the output same as the last stage input. There may be more than one input that produces the same outputs and the input that has the minimum leakage is selected as the present state input. Now in a similar way the assignments are made till the assignment of the input variables are made. The new input variables will produce a minimum leakage value. This value can be forced to the circuit when the circuit enters to the idle or sleep mode.

Algorithm to find MLV input without using Back – Search Algorithm

Step 1 : Start the process
Step 2 : Get the model circuit for which the leakage current to be reduced
Step 3 : Add decoder for each gate.
Step 4 : The one's counter is added to the decoder. This one's decoder counts the number of D_{ij}^k variable that are assigned a value ONE.
Step 5 : Compute the leakage of the gates by multiplying the counter value with the respective leakage values and let it be LT_k.
Step 6 : The total leakage current of the circuit is computed by. summing the all LT_k values
Step 7 : Calculate the leakage current of the circuit for various inputs.
Step 8 : Select the input vector that produces minimum leakage current and this input vector is called as Minimum Leakage Vector (MLV)
Step 9 : Force this MLV input whenever the circuit enters to the standby mode.
Step 10: Start the process.

Algorithm to find MLV input using Back – Search Algorithm

Step 1 : Start the process
Step 2 : Get the model circuit for which the leakage current to be reduced
Step 3 : Assign 'U' to the input variables
Step 4 : Select the last stage gates which produces output in the model circuit. Assign inputs to these gates such that it produces minimum leakage current and let this input be I.
Step 5 : Now select the gates that are connected to I and assign inputs to these gates so that it produces minimum leakage current with output as I
Step 6 : Repeat steps 4 and 5 till the input variables are assigned
Step 7 : Now the values present in the input variables gives the MLV input.
Step 8 : Force this MLV input whenever the circuit enters to the standby mode.
Step 9 : Stop the process.

The leakage current in the circuit depends on its input combinations. If the successive input has large number of variations, then the leakage current is more. If we reducing the frequency of the input signal, the number of transistors that gets charging and discharging can be reduced, so the leakage current can be reduced. The leakage values for all input combinations of a 3-input NAND gate is shown in Table 1.

The various leakages for the various 2-input gates such as NAND NOR and NOT gate that are used in the model circuit is shown in table 2. From the table it is verified that the leakage values of the gates depend on the type of the input combinations. This is due to the fact that the different transistors get ON for the different values of the input variables and so they have the different leakage values. The input variable that has a single value is fixed and the variables that are assigned both 0 and 1 should be marked as don't care. While using this input for the computation of leakage, only those inputs that is assigned as don't care is changed by keeping the remaining variables unchanged. In this way the number of inputs generated will be less than the actual number of inputs needed. Thus the Back-search algorithm is useful to find minimum leakage values instead of searching from the entire possible input combinations. Consider the model circuit and for the model circuit, the equivalent diagram to implement the back search algorithm is shown in Fig.9. Here the assignment starts from the output; the NOR gate has the minimum leakage for the input 1 1 and it is assigned without checking for its output. Now this 1's are the output to both NAND and NOR gates of the second stage.

Now from the table shown above, it is found out that the NAND gate has the minimum leakage for the inputs 0 0 and the NOR gate also has the minimum leakage when its input is 0 0. Now these inputs are assigned and this input becomes the output for the previous stage. In this way, the process is made till the input variable gets assigned. The output has the minimum leakage current when its input pattern is 1 1 and now the gates NOR and NAND checks from its truth table and selects the input patterns that has the output as 11. From this input patterns, it looks for the inputs that has minimum leakage. By doing this, NOR gate has 00 as the input that produces minimum leakage and the NAND gate has 01 as the input that produces minimum leakage current. In a similar way, the back-search is made till all the paths are traveled and now all the input variables will get assigned a value. Fig. 10 shows the Back – Search algorithm to find MLV input for model circuit 2.

RESULTS AND DISCUSSION

The LCN (Leakage Computing Network) structure is developed and is simulated with various input patterns by using Model Sim 5.4e. For various inputs, the corresponding leakage currents are computed and are compared with the standard reference value. The input having minimum leakage current is taken as MLV (Minimum Leakage Vector) input. Fig.11 shows the MLV generation for the model circuit 1 without using Back-Search algorithm. Since the model circuit has four inputs, it requires 16 clock cycles to find the MLV input. The leakage current of up to 55% can be saved by using this MLV input. Fig.12 shows the MLV generation for the model circuit 1 using Back-Search algorithm. For the given model circuit 1, it requires one clock cycle to find the MLV input. This MLV input gives the

leakage current closer to the standard minimum leakage current but the searching time is reduced. By using this Back – Search algorithm, leakage current of up to 44% can be saved. Fig.13 shows the MLV generation for the model circuit 2 without using Back-Search algorithm. Since the model circuit has four inputs, it requires 16 clock cycles to find the MLV input. Fig. 14 shows the MLV generation for the model circuit 2 using Back-Search algorithm. The MLV generated by both of these methods are same. But the Back – Search algorithm produces the MLV input in one clock cycle. For the given model circuit 2, the leakage current of up to 73% can be saved. From the simulation results, it is found that the Back - Search algorithm produces the MLV input that has leakage current closer to the standard minimum leakage with reduced searching time.

CONCLUSION

The analysis of the proposed method shows that up to 55% of leakage current is saved by using this technique. Although, the improved input vector control itself is an efficient technique, its performance can be improved by integrating with back-search algorithm. The back-search algorithm is used to reduce the searching time for finding the MLV inputs and the leakage current of up to 44% can be saved by using this algorithm with input vector control technique.

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Table 1: Different Leakage Values for 3-input NAND gates.

State	Leakage(pA)
000	3.21×10^{-12}
001	4.62×10^{-12}
010	4.67×10^{-12}
011	3.13×10^{-11}
100	6.47×10^{-12}
101	3.21×10^{-11}
110	3.67×10^{-11}
111	3.23×10^{-11}

Table 2: Leakage currents for NAND, NOR and NOT gates.

Inputs A B	Outputs (NAND)	Leakage Current (PA)
0 0	1	10
0 1	1	173
1 0	1	304
1 1	0	544
Inputs A B	Outputs (NOR)	Leakage Current (PA)
0 0	1	308
0 1	0	540
1 0	0	168
1 1	0	112
Inputs A B	Outputs (NOR)	Leakage Current (PA)
0 0	1	308
0 1	0	540
1 0	0	168
1 1	0	112

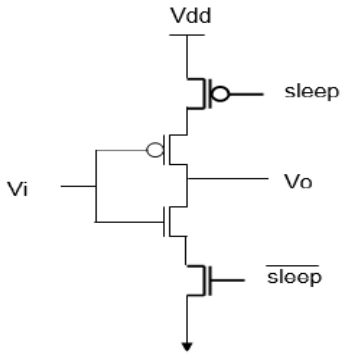

Fig.1: Power Supply Gating

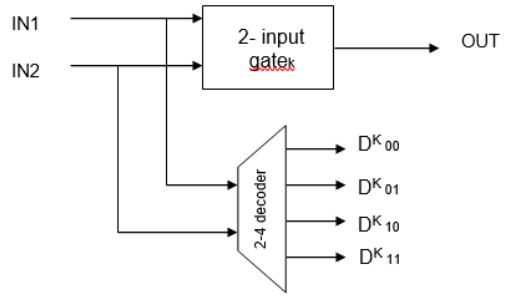

Fig.2: A 2-to-4 decoder indicating input combination of 2 input logic gates

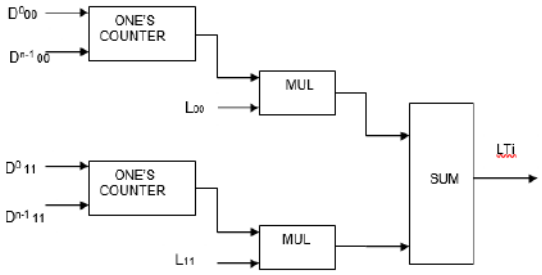

Fig.3: Contribution of all gates of type k to the total leakage

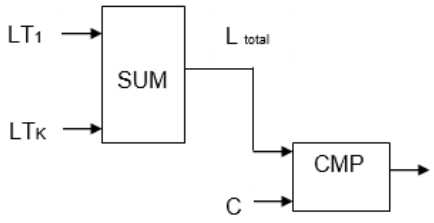

Fig.4: Comparing circuit leakages with C

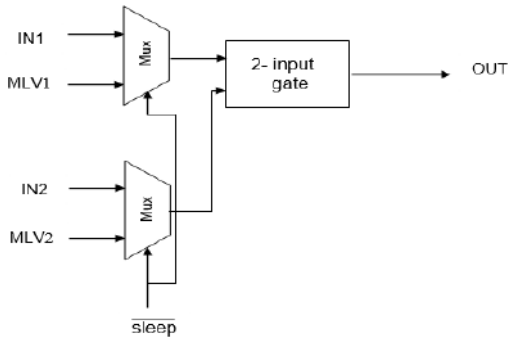

Fig.5: Final implemented circuit

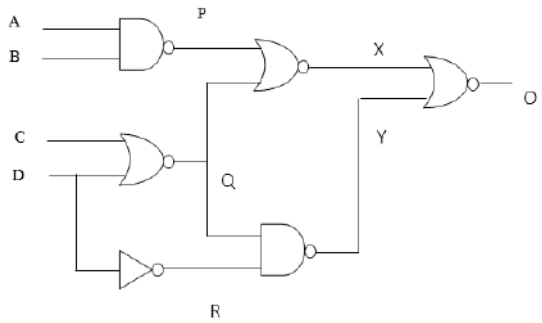

Fig.6: A Model Circuit 1

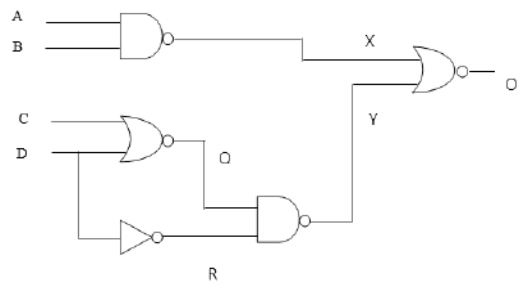

Fig.7: A Model Circuit 2

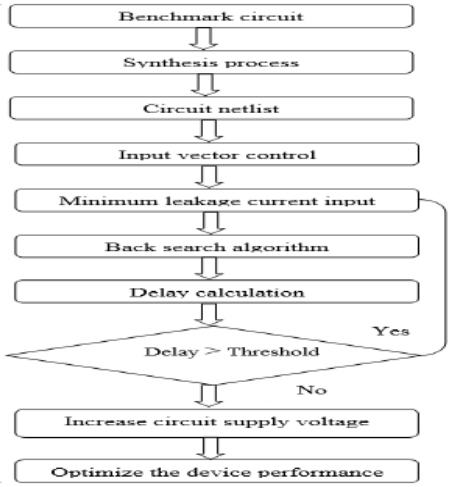

Fig.8: Proposed Method

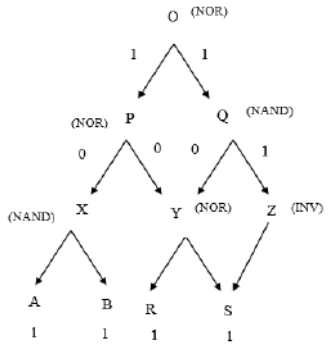

Fig. 9: A Back-Search Algorithm implementation to find MLV for Model Circuit 1

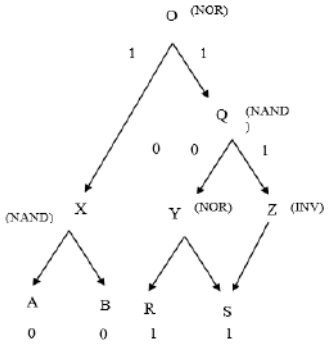

Fig. 10: A Back-Search Algorithm implementation to find MLV for Model Circuit 2

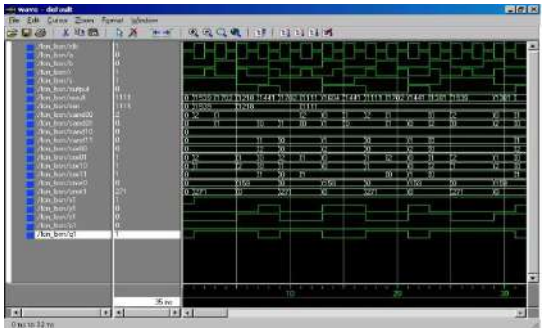

Fig. 11: MLV generation for the model circuit 1 without using Back – Search algorithm

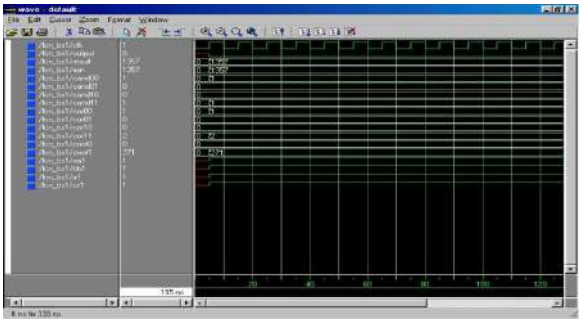

Fig. 12: MLV generation for the model circuit 1 using Back – Search algorithm

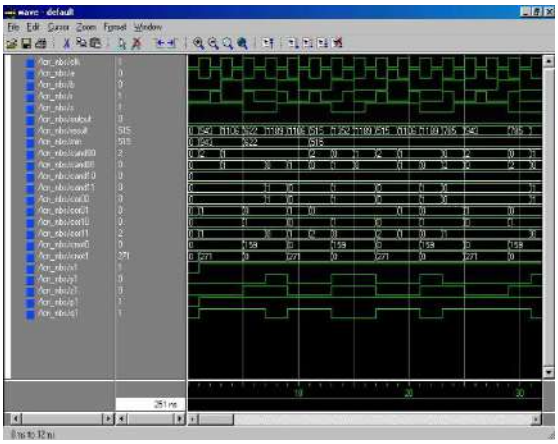

Fig. 13: MLV generation for the model circuit 2 without using Back – Search algorithm

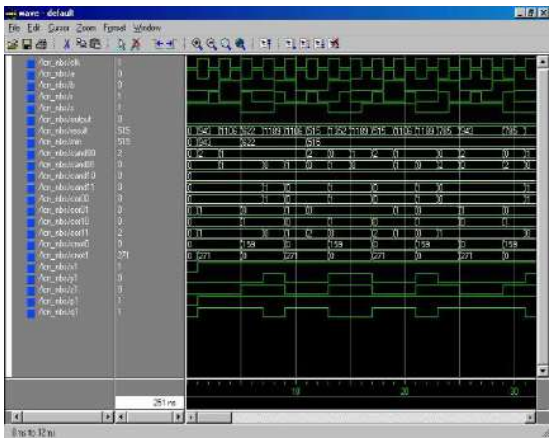

Fig. 14: MLV generation for the model circuit 2 using Back – Search algorithm

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RESEARCH ARTICLE

Analysis of Mechanical Characteristics on Aluminium Based Reinforcement with Titanium Dioxide and Silicon Carbide

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ABSTRACT

Aluminium alloy materials or simply composites are mixing of materials. It is made up of joining two or more materials in a way that the output of the materials has some design properties on improved properties. In this experiment the key to know the ability of the tested composition in Aluminium Metal Matrix composite. The impact strength of specimen is more along with 10 percentage composition of Titanium Dioxide and 10 percentage Silicon Carbide. With the addition of 5 % of Titanium Dioxide and Silicon Carbide reduces the impact strength. The Compression strength of specimen is high in addition with 10 percentage composition of Titanium Dioxide and 10 percentage Silicon Carbide. Further the addition of 5 % of Titanium Dioxide and Silicon Carbide decrease the Compression strength.

Keywords: Aluminium, Silicon, materials, Metal.

INTRODUCTION

The reinforcement surface can be coated to prevent a chemical reaction with the matrix. For example, carbon fibers are commonly used in aluminum matrix to synthesize composites showing low density and high strength. However, carbon reacts with aluminum to generate a brittle and water-soluble compound Al_4C_3 on the surface of the fiber. To prevent this reaction, the carbon fibers are coated with nickel or titanium boride. Composite materials are materials made from two or more constituent materials with particularly different in physical or chemical properties, while combined it gives a material with characteristics differ from the individual components. The individual components again separate and idle within the finished structure.

SELECTION OF MATERIALS

ALUMINIUM (Al) : (Matrix Component)
SILICON CARBIDE (SiC) : (Reinforced Material)
TITANIUM DIOXIDE (TiO_2) : (Reinforced Material)

Rare and expensive a century ago, aluminium has since been identified as the most common metal on earth, forming about eight percent of the earth's crust. It is the third most plentiful element known to man. Only oxygen and silicon (sand) exist in greater quantities

METHODOLOGY

Silicon carbide consists of tetrahedral of carbon and silicon atoms which has strong bonds in the crystal lattice. It gives very hard and strong material. Silicon carbide is not affected by any acids or alkalis or molten salts up to 800°C. The high thermal conductivity along with low thermal expansion with high strength results in material exceptional thermal shock resistant qualities.

RESULT AND DISCUSSION

Impact Test

The impact test gives the behaviour of material when subjected to high rates of loading usually in bending, torsion and tension

CONCLUSION

This study is the key to know the ability of the tested composition in Aluminium Metal Matrix composite. The impact strength of the material is high along with 10 percentage composition of Titanium Dioxide and 10 percentage Silicon Carbide. With the addition of 5 % of Titanium Dioxide and Silicon Carbide reduces the impact strength. The Hardness test of specimen is high in addition with 5 percentage composition of Silicon Carbide but decrease in 10 percentage of Silicon Carbide. Further the addition of 5 % of TiO2 decrease when compare to 10% of TiO2. The Compression strength of the material is huge in addition with 10 percentage composition of Titanium Dioxide and 10 percentage Silicon Carbide. Further increase of 5 % of Titanium Dioxide and Silicon Carbide decrease the Compression strength.

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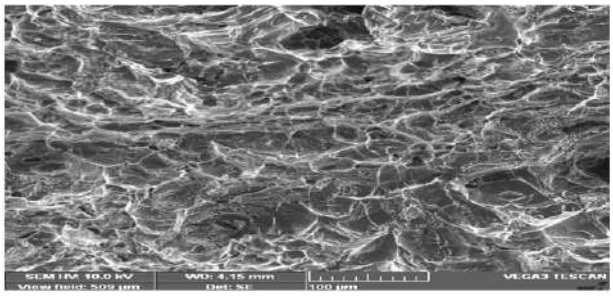
Figure: 1. Aluminium alloy

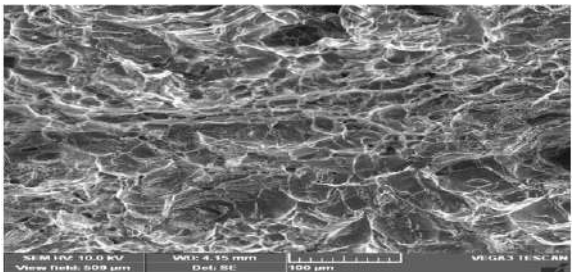
Figure: 2. Silicon carbide

Figure: 3. Electrical Resistance Furnaces with a Stirring Assembly

Figure: 4. Experimental Specimens – Impact test

Figure 5. Experimental specimen Hardness test





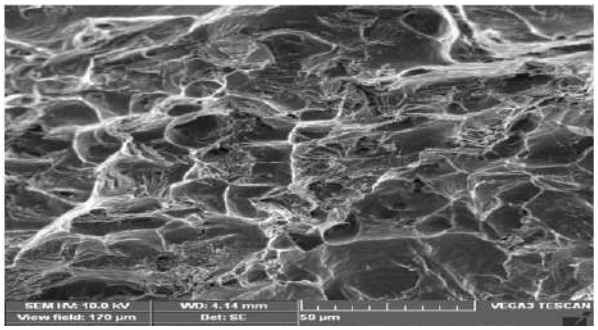
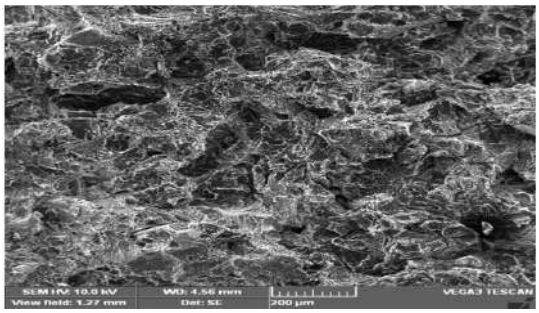


Figure 6. SEM TEST (SCANNING ELECTRON MICROSCOPE)
90%ALUMINIUM + 10% SILICON CARBIDE



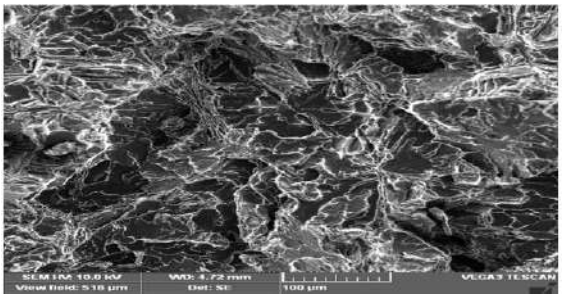
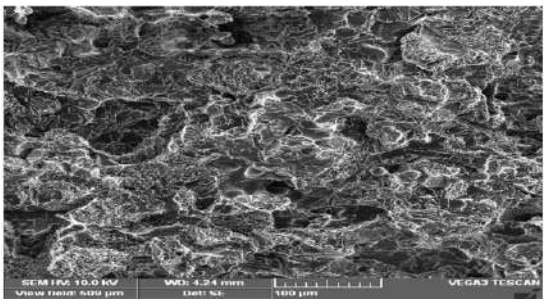


Figure 7. 90%ALUMINIUM + 05% SILICON CARBIDE



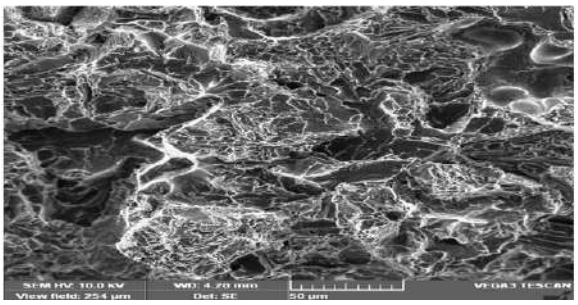
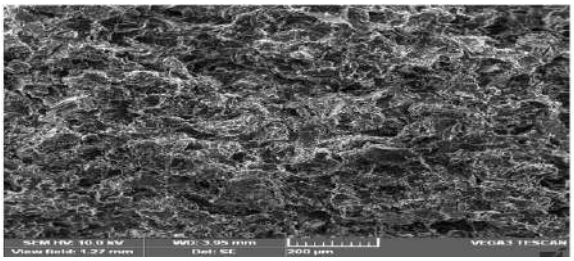


Figure 8. SEM TEST (SCANNING ELECTRON MICROSCOPE)
90%ALUMINIUM + 10% TITANIUM DIOXIDE



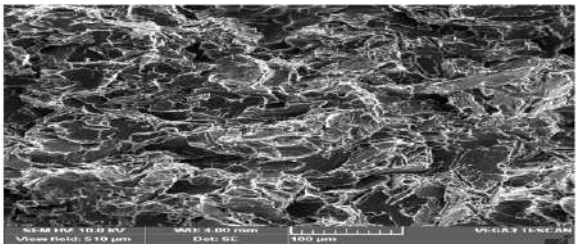


Figure 9. 90%ALUMINIUM + 05% TITANIUM DIOXIDE

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RESEARCH ARTICLE

Screening of *In-vitro* Anti-Diabetic Evaluation of Naaga Chendooram by Alpha Amylase and Alpha Glucosidase Enzyme Inhibition Assay

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ABSTRACT

Diabetes is a chronic, metabolic disease characterized by hyperglycemia, which leads over time to serious damage to the blood vessels, heart, kidneys, eyes and nerves. The basis of the anomaly in carbohydrate, fat, and protein metabolism in diabetes is deficient action of insulin on target tissues. α-amylase and α-glucosidase is enzymes responsible for hydrolyzing the carbohydrates and increase the postprandial hyperglycemia in diabetic patients. Inhibiting the activity of these two enzymes can control postprandial hyperglycemia, and reduce the risk of developing diabetes and diabetes complications Siddha system of medicine has potential herbal and herbo-mineral formulations for the Management of diabetes and diabetic complication without major side effects. The main objective of the present study is to evaluate the anti-diabetic potential of the herbal-mineral formulation of Naaga Chendooram (NC) by alpha-amylase and alpha- glucosidase enzyme inhibition assay. It was observed from the results of the present investigation that the test drug NC shown significant inhibition in alpha-amylase and alpha-glucosidase enzyme with the maximum inhibition of about. It was concluded from the study that the Siddha Herbo-mineral preparation Naaga Chendooram has significant control over the activity of both the metabolic enzymes such as alpha-amylase and alpha- glucosidase. Further clinical and preclinical studies is needed to identify the mechanism of action

Keywords: Diabetes Mellitus, Alpha-amylase, Alpha-glucosidase, AYUSH ,Siddha system, Naaga Chendooram

INTRODUCTION

Siddha an ancient, deep rooted scientific system of medical science, is one of the six recognized streams of Indian medicine, it is well prevalent and endorsed for more than two thousand years in south India and northeast Sri Lanka. In siddha literature, Mega Noi is classified into twenty types, in which four comes under Vatham, six under Pitham and ten under kabam. Madhumegam / Neerizhivu one of the 20 types of Mega Noi is classified under Pitham category [13]. In the past three decades, the prevalence of Diabetes mellitus has raised dramatically in countries of all income levels. There is a globally agreed target to halt the rise in Diabetes and Obesity by 2025. About 422 million people worldwide have Diabetes, 2 the majority living in low-and middle-income countries, and 1.6 million deaths are directly attributed to Diabetes each year. Both the number of cases and the prevalence of Diabetes have been steadily increasing over the past few decades[1]. There is no satisfactory effect on anti-diabetic modern drug on diabetic complication. But in Siddha system we have many herbals and herbo-mineral formulation possess anti diabeticactivity as well as same formulation have properties to control diabetic complications, Present study aimed at evaluating the anti-diabetic potential of the siddha formulation Naaga Chendooram by alpha amylase and alpha glucosidase enzyme inhibition assay.

MATERIALS AND METHODS

***In-vitro* Alpha Amylase Enzyme Inhibition Study**

Method Adopted

The spectrophotometric assay method [5].The enzyme α-amylase (0.5 U/ml) was prepared by mixing 3.24 mg of α-amylase in 100 ml of phosphate buffer (pH 6.9). Test Sample (NC) was prepared in the serial dilution of the concentration ranges from 100,200,300,400 and 500 µg/ml using DD water. Acarbose 100 µg/ml used as a reference standard. About 600 µl of test sample were added to 30 µl of α-amylase enzyme solution and incubated at 37°C for 15 min. To this reaction mixture, 370 µl of substrate, 2-Chloro-4-Nitrophenyl-α-Maltotrioside ($CNPG_{3-}$ 0.5 mg/ml) was added, mixed and for incubated 37°C for 10 min. Finally, absorbance was measured at 405 nm against blank in spectrophotometer. A control reaction was carried out without the test sample. Percentage inhibition was calculated by the following formula. Percentage inhibition

$$\%\text{Inhibition} = \frac{\text{Absorbance}_{\text{Control}} - \text{Absorbance}_{\text{Test}}}{\text{Absorbance Control}} \times 100$$

***In-vitro* α-Glucosidase Enzyme Inhibition Study**

Method Adopted

The spectrophotometric assay method[6].

Test Solution

Test Sample (NC) was prepared in the serial dilution of the concentration ranges from 100,200,300,400 and 500 µg/ml using DD water. PNPG (p-nitrophenyl-α-D -glucopyranoside**)**: 20 mM PNPG prepared by dissolving 603 mg PNPG in 100 ml of PBS.

Enzyme

The α-glucosidase enzyme solution was prepared by dissolving 0.5 mg α-glucosidase in 10 ml phosphate buffer (pH 7.0) containing 20 mg bovine serum albumin. About 10 µl of each of the test sample at varying concentration along with Acarbose 100 µg/ml used as a reference standard were added to 250 µl of 20 mM p-nitrophenyl-α-D -glucopyranoside and 495 µl of 100 mM phosphate buffer (pH 7.0). It was pre-incubated at 37°C for 5 min and the reaction started by addition of 250 µl of the α-glucosidase enzyme solution prepared by 0.5 mg α-glucosidase in 10 ml phosphate buffer (pH 7.0) containing 20 mg bovine serum albumin, after which it was incubated at 37°C for

exactly 15 min. 250 µl of phosphate buffer was added instead of enzyme for blank. The reaction was then stopped by addition of 1000 µl of 200 mM Na_2CO_3 solution and the amount of p-nitrophenol released was measured by reading the absorbance of sample against a sample blank (containing PBS with no sample) at 405 nm using UV visible spectrophotometer.

RESULT AND DISCUSSION

Diabetes mellitus (DM) is a disease with an imbalance of control of blood glucose levels and insulin secretion. Considering the fact that diabetes is considered a chronic metabolic disease, different antidiabetic treatments with established drugs are often not a single-dose program as most drugs require frequent injections, sometimes for the entire life of the diabetic patient. Multiple strategies have been explored in the management of DM. Stimulation of Adenosine monophosphate-dependent protein kinase (AMPK) (Biguanides-Metformin); blockage of ATP-gated K + channels in β cells (Sulfonylureas-Glipizide); stimulation of peroxisome proliferator–activated receptors activities (PPAR ϒ) (Thiazolidinediones-Rosiglitazone); and glucagon-like peptide-1 (GLP-1) (Exenatide by Etta) modulation[7,8].The usage of herbal medicine as complementary strategies in the existing treatment of diabetes and its complications in the growing world and herbal plants and many plants in different countries are known to have anti-diabetic effects[10].

Postprandial hyperglycemia is distinguished by hyperglycemic spikes that induce endothelial dysfunction, inflammatory reactions and oxidative stress, which may lead to the progression of atherosclerosis and the occurrence of cardiovascular events. In the control of postprandial hyperglycemia (PPHG) enhancement of insulin secretion, insulin sensitivity or lower glucose production in the liver are acquired by inhibiting the activity of alpha-amylase and alpha-glucosidase, which are main two carbohydrate hydrolyzing enzymes are responsible for postprandial hyperglycemia, hence by reducing PPH reduces the major risk factor for cardiovascular complications in diabetes patients. Acarbose is drug for the treatment of adults with type 2 diabetes mellitus; it's a complex oligosaccharide that acts as a competitive, reversible inhibitor of pancreatic alpha-amylase and membrane-bound intestinal alpha-glucoside hydrolase. Though effective in controlling PPHG, these inhibitors are not desirable for long-term treatment due to their gastrointestinal adverse effect [11]. The present investigation that the Siddha formulation Naaga Chendooram (NC)compared with standard drug acarbose. The result showed significant inhibition in alpha-amylase enzyme with the maximum inhibition of about 62.31 ± 1.828%and the corresponding IC50 is 415.4 ± 7.394µg /ml.

Standard acarbose exhibited significant inhibition in alpha-glucosidase enzyme with the maximum inhibition of about 98.63 ± 1.66% and the corresponding IC50 is 36.286 ± 3.688µg /ml and NC showed significant inhibition in alpha-glucosidase enzyme with the maximum inhibition of about 60.83 ± 4.794 % and the corresponding IC50 is 411.4 ± 62.52 µg/ml. Standard acarbose exhibited significant inhibition in alpha-amylase enzyme activity with the maximum inhibition of about 99.16 ± 0.3771 % and the corresponding IC50 26.89 ± 6.278 µg /ml. Naaga Chendooram compare previous study *In- vitro* antidiabetic activity of Aavarai Kirutham in alpha-amylase enzyme assay, that result showed that Naaga Chendooram significant inhibition in alpha-amylase enzyme with the maximum inhibition of about 62.31 ± 1.828%and the corresponding IC50 is 415.4 ± 7.394µg /ml over Aavarai Kirutham exhibited inhibition in alpha-glucosidase enzyme with the maximum inhibition of about 56.26± 6.76%and the corresponding IC50 is 419.8 ± 117.5 µg /ml. In alpha-glucosidase enzyme assay, Naaga Chendooram showed significant inhibition in alpha-glucosidase enzyme with the maximum inhibition of about 60.83 ± 4.794 % and the corresponding IC50 is 411.4 ± 62.52 µg/ml over Aavarai Kirutham exhibited inhibition in alpha-amylase enzyme activity with the maximum inhibition of about 596.5 ± 18.8 µg/ml and the corresponding IC50 26.89 ± 6.278 µg /ml.

CONCLUSION

It was observed from the results of the present investigation that the formulation NC shown significant inhibition in alpha amylase enzyme with the maximum inhibition of about 62.31 ± 1.828%and the corresponding IC50 is 415.4 ± 7.394µg /ml. Standard acarbose exhibited significant inhibition in alpha glucosidase enzyme with the maximum inhibition of about 98.63 ± 1.66% and the corresponding IC50 is 36.286 ± 3.688µg /ml. It was observed from the results of the present investigation that the formulation NC shown significant inhibition in alpha glucosidase enzyme with the maximum inhibition of about 60.83 ± 4.794 % and the corresponding IC50 is 411.4 ± 62.52 µg/ml. Standard acarbose exhibited significant inhibition in alpha amylase enzyme activity with the maximum inhibition of about 99.16 ± 0.3771 % and the corresponding IC50 26.89 ± 6.278 µg /ml. Naaga Chendooram has significant *in- vitro* antidiabetic activity on comparing both standard drug and Aavarai Kirutham from discussion. It was concluded from the study that the Siddha Herbo-mineral preparation Naaga Chendooram has significant control over the activity of both the metabolic enzymes such as alpha-amylase and alpha- glucosidase. Further clinical and preclinical studies is needed to identify the mechanism of action.

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ouragement and support with fortitude time to time throughout the course of my dissertation work. I express my sincere thanks to Dr. H. Vetha Merlin Kumari M.D(S), Ph.D., Professor, Department of Maruthuvam, National Institute of Siddha, Chennai - 47. I express my sincere thanks to Dr. H. Nalini Sofia M.D(S), Ph.D., Associate Professor, Department of Maruthuvam, National Institute of Siddha, Chennai - 47. I express my sincere thanks to Dr. C. MarrySharmila M.D(S), Assistant professor, Department of Maruthuvam, National Institute of Siddha, Chennai - 47. I express my sincere thanks to Dr. B. Anbarasan M.D(S), Assistant professor, Department of Maruthuvam, National Institute of Siddha, Chennai – 47.

CONFLICT OF INTEREST: NIL

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Table:1 Percentage inhibition of test drug NC on Alpha Amylase enzyme Inhibition Study

Concentration (µg/ml)	% Inhibition of NC
100 µg/ml	16.32 ± 0.7436
200 µg/ml	26.36 ± 1.649
300 µg/ml	35.28 ± 2.684
400 µg/ml	53.57 ± 6.417
500 µg/ml	62.31 ± 1.828
Standard Acarbose	98.63 ± 1.66

Data are given as Mean ± SD (n=3)

IC50 Values for Alpha Amylase Enzyme inhibition by NC and STD

Test Drug / Standard	IC50 Value of Alpha Amylase enzyme inhibition ± SD (µg /ml)
NC	415.4 ± 7.394
Standard- Acarbose	6.286 ± 3.688

Data are given as Mean ± SD (n=3)

Table 2: Percentage inhibition of test drug NC and STD on α-Glucosidase enzyme Inhibition Study

Concentration (µg/ml)	% Inhibition of NC
100 µg/ml	21.6 ± 6.765
200 µg/ml	32.92 ± 7.993
300 µg/ml	41.59 ± 6.827
400 µg/ml	48.03 ± 6.567
500 µg/ml	60.83 ± 4.794
Standard- Acarbose	99.16 ± 0.3771

Data are given as Mean ± SD (n=3)

IC50 Values for α-Glucosidase enzyme Inhibition Assay by NC and STD

Test Drug / Standard	IC50 Value of α-Glucosidase enzyme inhibition ± SD (µg /ml)
NC	411.4 ± 62.52
Standard- Acarbose	26.89 ± 6.278

Data are given as Mean ± SD (n=3)

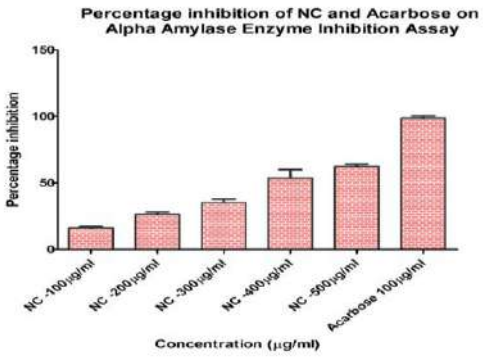

Figure 1: Percentage inhibition of test drug NC on Alpha Amylase enzyme Inhibition Study

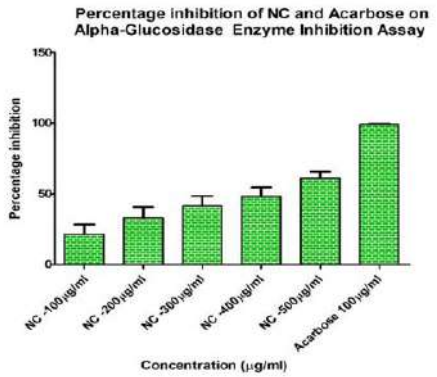

Figure 2: Percentage Inhibition of Test Drug Nc And Std On A-Glucosidase Enzyme

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RESEARCH ARTICLE

Plants and Electricity- Sui-Generis Approach

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ABSTRACT

Sustainable development – not merely a buzz word but the need of the hour,for the current and future generations.' Sustainable revolution' needs immediate enforcement, consciously and at many different levels and in many different spheres, simultaneously. One of the recourse towards fulfilment of the same is adopting weak energy sources. Researchers discovered that plants can generate (by a single leaf) more than 150 volts, enough to power 100 LED light bulbs. The use of living plants to harvest energy is an alternative as it is environmentally friendly, cost effective and most important easily available. The study began with testing different types of plants from different families for their ability to generate electricity and succulent plants, especially *Aloe vera* was found to generate maximum voltage. It was found that the power output of the plant depends on the area occupied by the connecting wires and the photosynthetic efficiency of the plant. Factors such as Light intensity, Carbon dioxide concentration, temperature, water to name a few affect photosynthesis of plants. Electricity produced is taken from the plant with nanotubes by interrupting photosynthesis to capture the electrons before the plant uses them to make sugars. Correspondingly, using Copper wires as connecting chords helps in the generation of maximum voltage by forming a green circuit. The objective of this project was to produce electricity using plants and also to study the efficiency of living plants as practicable power sources.

Keywords: Sustainable development, Nano tubes, Electricity, Photosynthesis, Green circuit

INTRODUCTION

Our world is severely affected due to the extensive use of burning fossil fuels that raises the level of carbon dioxide in the atmosphere thus resulting in the greenhouse effect. Greenhouse gases gradually increase the temperature of the Earth's surface and therefore bring us a warmer atmosphere and collapsing global environment [1]. There is no doubt that climate change is upon us. Therefore, increasing use of renewable energies has been encouraged by

government of many countries, as it provides an excellent opportunity for mitigation of greenhouse gas emission and reducing global warming through substituting conventional energy sources [2-4]. Recently, a new form of energy source based on plant was investigated by many researchers as the weak energy sources. It was found that certain plants can produce a continuous small amount of electrical power at both day and night, unlike solar power, which is only functional in the presence of light. This new source of energy from plants is renewable, pollution free and sustainable as long as the plant is alive. Plants are sensitive to light due to its photoreceptors, which can be categorized as phytochromes, blue/UV-A and UV-B photoreceptors. The plant uses light to differentiate day and night via photoperiodism and to enable the generation of energy via photosynthesis[5]. This paper mentions different procedures to harvest weak electricity from living plants and how different varieties of plants around us can generate electricity that can be used for low consumption devices.

MATERIALS AND METHODS

Plants from different categories (flowering, succulents, decorative etc) and different families (Mahogany, Fabaccae, Lamiates) are taken into consideration. The connecting wires made of copper (plastic insulated, of 16 gauge thickness) are used to pierce the plant to measure the Voltage and resistance offered by the sample. After every reading, the wires are cleaned with acetone before measuring the values for another plant. Using Ohm's law,i.e, i=V/R, where I = current, V = Voltage, R = resistance offered, the current generated from the plants is calculated. In the experiment, copper and zinc electrode combination is more reactive in the electrochemical series compared to other combinations of electrodes. It causes both electrodes to generate a higher amount of electricity when embedded into the Aloe Vera leaf gel. The gel acts as the electrolyte and causes Oxidization, which occurs in zinc electrode, causes the Zn atom to change into Zn2+ ion and releases electrons from the zinc electrode which flows through the external wire to the load (multi-meter) and later towards the copper electrode. Reduction takes place at the copper electrode.

RESULTS AND DISCUSSIONS

When a plant is subjected to external stimuli other than light such as mechanical stress from wounding the plant [6,7], temperature variance [9], and watering disparity [10-12], the intercellular process within the plant will produce an electric potential signal in response to these external stimuli. These responses are due to the physiological activities of plants in the cellular cell at the microscopic level [13-14]. The electric potential difference generated in the response of the physiological activities to the external stimuli is measured at most at tens of milli volts [15]. However, electrical conduction will differ from plants to plants. As plants constitute of complex conductive and insulated elements, these will affect the electron flow ability among different species of plants. From the four tables, the most promising type of plants, which can generate a higher amount of electrons, is the succulent family of plants. Succulent plants are water-retaining plants, which can store water in their leaves, stems, and roots in order to survive in a dry environment. Aloe Vera plant is a succulent species of plants, which can survive in dry environment for a long period and is an evergreen perennial It is a short stemmed plant growing to a height of 50 cm to 100 cm and leaves arising from the base spirally around its stem at the center and has thick fibrous root. The size of the leaves vary based on the species but are thick, fleshy, green(with variegated patterns in some).

This plant is termed as "Lily of Desert" owing to its ability to store a high amount of water in its leaves. Its leaves are green, thick and fleshy with spiny edges at both sides. These fleshy leaves have pulps that can retain a high amount of water in the form of transparent gel. A transverse section of the Aloe Vera leaf shows that it consists of three layers – rind, latex, and inner gel. The outer layer is called the rind within which are the vascular bundles. The rind is protective in function and responsible for photosynthesis. The second layer is the latex, which is a sap and oozes as yellow secretions with a strong bitter taste on cutting ,it contains anthraquinones and glycosides. The third layer is a clear semi-solid fleshy gel and contains 98-99% water, and remaining is of polysaccharides, glucomannans, lipids, amino acids, vitamins, sterols, minerals, and enzymes. This part is the significant part of the plant and acts as an

electrolyte in the electrochemistry process to generate electrical energy. Hence, the conductivity of the plants is enhanced with its relatively abundant of water in its bodies [16]. In Table 2, we can notice that vegetable and fruit plants also conduct electricity. This is because they contain a large amount of water and other ingredients such as citric acid and ascorbic acid increase the conductivity, and in some cases, the acidic content is high enough to create voltage that can power small electronics. Citric acid is found in the banana stem and when two electrodes — one zinc and one copper are placed in a cell and connected them to two lengths of banana stems measuring one foot each produced three volts of electricity, enough to light one LED bulb for three hours. Also a few other decorative plants like Lucky Bamboo, Money plant, Night queen plant etc seem to be generating considerably good amounts of electricity. Plants like *Senna auriculata*, Insulin plant which are commonly found in our neighbourhood are also generating electricity. But among all the plant samples, Aloe Vera is found to be generating the maximum current because of the inner semi-solid fleshy gel which acts as the electrolyte. The gel contains 20 minerals (Calcium, Magnesium, Zinc, Chromium, and Selenium), 12 vitamins (A, B, C, E, and folic acid), 20 amino acids, over 200 active components including enzymes and polysaccharides. The presence of these minerals and acids in *aloe vera* leaf helps in generation of electricity.

CONCLUSION

In this paper, we tried to check the amount of current generated by various plants found in our neighborhood or a nursery. We noticed how a few decorative plants that we find on the roads can be used to power the street lights, road intersections, dividers, pedestrian crossings. Succulents, Banana trees and the other electricity generating plants can be used to develop low consumption devices like eco friendly batteries, remote sensors, microprocessors etc. This technology with further development and enhancement can also be used in the areas of energy scarcity in the future.

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Table 1: The Voltage and Resistance Values of Different Medicinal Plants

Name of the plant	Voltage mV	Resistance KΩ	Current(i)μA
Aloe vera Aloe barbadensis(Family: Asphodelaceae)	123	19	6.684
Tulasi*Ocimum tenuiflorum*(Family: Mints)	22.4	0.103	0.0969
Insulin plant *Chamaecostus cuspidatus*(Family: SpiralGinger)	9.3	9.8	0.948
Neem plant *Azadirachta indica*(Family: Mahogany)	19.3	0.127	0.1519
Nilavembu *Andrographis paniculata*(Family:Acanthaceae)	20.4	550	0.0037
SennaAuriculata*CassiaDensistipulataTaub* (Family: Fabaceae)	67.3	71.3	0.9438
Amla *Phyllanthus emblica* (Family: Phyllanthaceae)	5 .0	500	0.01
Lemon grass Cymbopogon (Family: Grass)	12.0	240	0.05

Table 2: The Voltage and Resistance Values Of Different Vegetable And Fruit

Name of the plant	Voltage mV	Resistance KΩ	Current(i)μA
Amaranthus Amaranthus viridis(Family: Amaranthaceae)	8.5	662.0	0.012839
Drumstick *Moringa oleifera*(Family: Moringaceae)	11.8	1070.0	0.011028
Custard Apple *Annona reticulata*(Family:Annonaceae)	0.2	6.8	0.0294
Banana musa (Family: Musaceae)	0.108	0.181	0.59668
Mango *Mangifera indica* (Family: Cashews)	13.0	39.0	0.333
Almond *Prunus dulcis* (Family: Rosaceae)	11.3	120.0	0.094166
Green Chillies *Capsicum annuum*(Family: Solanaceae)	5.0	48.0	0.10416

Table 3: The Voltage And Resistance Values Of Different Succulent Plants

Name of the plant	Voltage V	Resistance MΩ	Current(i) μA
Burro's tail *Sedum Morganianum*(Family: Stonecrops)	0.022	0.190	0.11578
Graptoveria*Graptoveria 'Debbi'* (Family: Crassulaceae)	0.047	0.273	0.17216
GraptosedumVera Higgins *Graptosedum* (Family: Crassulaceae)	0.020	0.100	0.2
Succulent Bush Senecio *Senecio barbertonicus*(Family:Daisy)	0.032	0.105	0.30476
Echeveria "Violet Queen" *Echeveria elegans* (Family: Stonecrops)	0.04	0.119	0.33613

Table 4:The Voltage And Resistance Values Of Different Decorative Plants

Name of the plant	Voltage mV	Resistance MΩ	Current(i) μA
Marjoram *Origanum majorana* (Family: Mints)	14.2	16.03	0.000858
Poinsettia (Family: Spurges)	0.16	0.075	0.002133
Sadabahar(Family: Dogbanes)	20.9	0.33	0.06333
Rose *Rosa* (Family: Rosaceae)	3.6	0.08	0.045
Hibiscus *Hibiscus rosasinensis* (Family: Mallows)	0.15	0.022	0.006756
Marigold *Tagetes*(Family: Daisy)	16.8	0.609	0.027586
Pinwheel flower *Tabernaemontana divaricata*(Family: Apocynaceae)	0.243	0.433	0.000561
Crossandra infundibuliformis(Family: Acanthaceae)	14.4	0.88	0.016363
Money Plant *Epipremnum aureum*(Family: Arums)	65.0	0.258	0.251937
Allamanda creeper *Allamanda cathartica*(Family: Dogbanes)	8.5	0.08	0.10625
Stick plant *Euphorbia tirucalli*(Family: Euphorbiaceae)	26.3	0.34	0.077352
Night queen plant *Cestrum nocturnum* (Family: Nightshade)	12.0	0.085	0.141176
Cactus Opuntia (Family: Cactaceae)	310.0	3.18	0.09748
Canna Indica *Sierra leone Arrowroot* (Family: Cannaceae)	112.0	1.14	0.09824

Figure I: Experimental set up

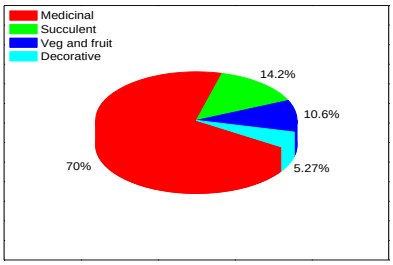

Figure II: Power profile of different class of plants

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RESEARCH ARTICLE

Application of Remote Sensing and Geographical Information System in Agriculture

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ABSTRACT

This paper provides an outline of precision agriculture technologies comprising remote sensing and geographical information system. Agriculture is providing all essential needs to humans like food and fiber. Precision agriculture is a different kind of agricultural production, where the usage of technology has been incorporate in farming. Remote sensing is a technology that detects the spectral signature of any object. The electromagnetic spectrum will differs the responses of the objects present in different locations. The distinctive responses are used to differentiate the objects such as vegetation, water and soil. Remote sensing is two types viz, active remote sensing is when a signal is emitted by a satellite or aircraft and its reflection by the object is detected by the sensor. LiDAR, Radar, InSAR, PSInSAR, SAR, SRT, Squee SAR are the active sensors and Passive remote sensing is when the reflection of sunlight is detected by the sensor. Aerial photography, FLIR, geodetic survey are passive remote sensing techniques. Geographical information system is a computer system designed for capturing, storing, integrating, analyzing and displaying data from geographical angle. Geographical information system has a substantial role to play in agriculture. Geographical information system minimize the fertilizer inputs and enhance farm returns. Balancing the inputs and outputs on a farm is essential to its success and profitability. Remote sensing and geographical information system agricultural application areas are crop identification, crop condition monitoring and also detection of pests and diseases, plant stress, vegetative indices, canopy transpiration and crop stress. In one way world's population is increasing, meanwhile demand of food also increasing. Site-specific farming is the best way for production of crops and minimizes the precarious practices following in agriculture.

Keywords: Agriculture, Precision farming, Remote sensing and Geographical information system.

INTRODUCTION

Agriculture is the backbone of Indian economy and the essential sector for ensuring food security. India is the one of the world's largest producer of pulses, jute and second largest producer of rice, wheat, sugarcane, cotton, fruits and vegetables. It is also a leading producer of milk, poultry, fish, livestock, spices and plantation crops (Acharya *et al.,* 2018). Present days processing, marketing and distribution of crops and livestock products are all familiar as part of current agriculture. Consequently, agriculture may possibly referred to as the production, processing, promotion and distribution of agricultural products. Agriculture plays a vital role in the entire life of a given economy. Agriculture also affords employment opportunities to large percentage of population by providing food and raw material. To produce food and raw materials need to apply machineries in agriculture practices (Ray, 2016). Mainly in developed countries tending to support greater energy inputs using large machineries and increased applications of chemicals and fertilizers through industries. Whereas these practices having social and environmental implications such as soil erosion, salinization, soil fertility, compaction of subsoils, soil and water pollution, they have generally supported the food and fiber needs of a rapidly growing population. A standard should shift towards a new method of production that ensures safe and sustainable agriculture is needed. Around the world, Precision farming is a part of sustainable agriculture is changing the way people is farming as it offers a endow of potential benefits in profitability, productivity, sustainability, crop quality, environmental protection, food safety and rural economic development. Precision agriculture is a integrated way of standardizing to approach aiming to increase the efficiency of resource use and to reduce the improbability of decisions required to manage changeability on farms (Liaghat and Balasundram, 2010). Agriculture production system have benefited from incorporation of technologies. The industrial age brought mechanization and synthesized fertilizers to agriculture. The information age offered genetic engineering and automation. The information age brings the potential for integrating the technological advances into precision agriculture (Whelan *et al.,* 1997). Precision agriculture is intellectualized by a system approach to reorganize the total system of agriculture towards a low-input, high efficiency, sustainable agriculture. Precision agriculture is the new approach mainly paybacks from the development and merging of several technologies. Including the geographic information system (GIS), mobile computing, advanced information processing, remote sensing and telecommunications (Yousefi, 2015). The main aim of precision agriculture is to reduce the cost of cultivation, improved control and improved resources use efficiency with the help of information received by the sensors fitted in the farm machineries.

REMOTE SENSING (RS)

Remote sensing in agriculture refers to the art and science of observing and obtaining information on crop and soil characteristics using sensors attached to satellite, aircraft and ground based platforms. Remote sensing has a great potential for precision agriculture as it provides the key of monitoring the spectral and spatial changes over time high resolution. The main application of remote sensing in agriculture includes the biomass and yield estimation, vegetation vigor and drought stress monitoring, assessment of crop phenological development, crop land estimation and mapping (Gebeyehu, 2019).

REMOTE SENSING TECHNIQUES

Remote sensing techniques are divided into active and passive remote sensing. Active remote sensing is when a signal is emitted by a satellite or aircraft and its reflection by the object is detected by the sensor. LiDAR, Radar, InSAR, PSInSAR, SAR, SRT, SqueeSAR are the active sensors. Passive remote sensing is when the reflection of sunlight is detected by the sensor. Aerial photography, FLIR, geodetic survey, hyperspectral imaging, long wave infrared, multispectral imaging, near infrared surveys, oblique aerial and ground visible band and thermographic imaging, radiometrics, SWIR, stereo satellite imagery.

GEOGRAPHICAL INFORMATION SYSTEM (GIS)

GIS is a computer system designed for capturing, storing, integrating, analyzing and displaying data from geographical angle. It is powerful set of tools for collecting data, storing and recovering the data. Balancing the inputs and outputs on a farm is essential to its success and profitability. GIS combines location data with both quantitative and qualitative information about the location, allowing you to visualize, analyze and report information through maps and charts. GIS is identified as a system used to manage infrastructure assets, natural resources and any objects as per requirement. GIS based mapping application can help to identify location of crops growing across the country and to adapt different variables, monitor the health of individual crops, estimates yields from a given field and maximize crop production. By using land use and primary food crop statistics, along with data collected by different tools including mobile devices able to identify areas in need and underlying causes of food insecurity, GIS is an instrumental in the effort to end global hunger and it is an integral part of automated field operations (Vibhute, 2013).

ROLE OF REMOTE SENSING (RS) AND GEOGRAPHICAL INFORMATION SYSTEM (GIS) IN AGRICULTURE

Agriculture resources are important renewable dynamics natural resources. In India, the agricultural sector alone sustains the livelihood of around of 70% of the population and contributes nearly 35% of the net national product. Remote sensing systems, having capability of providing regular, synoptic multi temporal and multi spectral coverage of the country, plays a vital role in providing such information. A large number of experiments have been carried out in developing techniques for extracting agricultural related information from ground borne, air borne and space borne data. Some of the broad remote sensing and geographical information system agricultural application areas are crop identification, crop condition monitoring like moisture stress due to drought, nutrient stress due to insufficient availability in the soil, flooding, salinity. Detection of plant stress, vegetative indices, canopy transpiration and crop stress, cropping system analysis, crop biophysical characterization like fraction of vegetative cover, chlorophyll content, green leaf area index, yield forecasting, erosion inventory, sand dune characterization, soil texture and hydraulic properties, soil drainage, soil surface roughness and precision farming practices. The process of data acquisition and analysis is very fast through Geographical Information System (GIS) as compared to conventional methods. Apart from agriculture, even remote sensing and geographical information system is used in numerous fields, including geography, land surveying. It also has military, intelligence, commercial, economic, planning and humanitarian applications.

CONCLUSION

In order to follow best technological practices in precision agriculture like remote sensing and GIS is best. Precision agriculture makes farm planning both easier and more complex. Remote Sensing and Geographical Information System technology has the prospective of modernizing the detection and characterization of agriculture production and productivity based on different traits of crop and soil. World population has increasing and need for increase agricultural production to feed world. RS and GIS are improved technologies which is very useful in detecting and management of various crop issues even at small or large agriculture land holdings. Further research works are needed to improve to understand the different aspects of techniques to confirm the possible use of RS and GIS technologies in repetitive investigation and assessment activities ranging from precise farming systems to global food production.

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RESEARCH ARTICLE

ζ-Open Sets in Nano Topological Space

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ABSTRACT

In this paper, we introduce the concept of ζ nano topological space which is the extension of nano topological space. In nano topology, there is a maximum of five open sets ϕ, $\mathcal{L}_{\mathcal{R}}$, $\mathcal{U}_{\mathcal{R}}$, $\mathcal{B}_{\mathcal{R}}$, and V. But here, we concentrate only on three open sets are $\mathcal{L}_{\mathcal{R}}$, $\mathcal{U}_{\mathcal{R}}$, and $\mathcal{B}_{\mathcal{R}}$. Using these three open sets, we increase the number of open sets in ζ-nano topology. Also we establish the basic concept like interior, closure, exterior, and frontier in ζ-nano topology. We discuss some elementary properties for $\zeta_{\mathcal{N}}$-interior, $\zeta_{\mathcal{N}}$-closure, $\zeta_{\mathcal{N}}$-exterior, and $\zeta_{\mathcal{N}}$-frontier. Finally, we investigate some results of ζ-nano topological space.

Keywords: *ζ-nano topological space, $\zeta_{\mathcal{N}}$-i-(E), $\zeta_{\mathcal{N}}$-c-(E), $\zeta_{\mathcal{N}}$-e-(E) and $\zeta_{\mathcal{N}}$-f-(E)*

INTRODUCTION AND PRELIMINARIES

Thivagar and Richard [3] introduce the idea of nano topology($\mathcal{N}$). In this area, it has only a maximum of five open sets. That is empty, universe set (V), $\mathcal{L}_{\mathcal{R}}$, $\mathcal{U}_{\mathcal{R}}$, and $\mathcal{B}_{\mathcal{R}}$. It is the smallest topology in topological space. Arther steen and Arthur Seebach [4] developed the concept of finding new results and counter examples in the area of interior, closure, exterior, and frontier in topology. Roseman [8] studied the complement results based on interior and closure. Also characterized the relationship between interior, closure, and frontier. In this paper, we extend the number of open sets in nano topology using the members which are already present a member in nano topology is $\mathcal{L}_{\mathcal{R}}$, $\mathcal{U}_{\mathcal{R}}$, and $\mathcal{B}_{\mathcal{R}}$ are called ζ-nano topological space. We construct some of the elementary concepts on basic results. Again, we approach some new results using interior, closure, and frontier in ζ-nano topological space.

Definition 1.1 [3] Let $\mathcal{V}$ be a non-empty finite set of members are called the universe and $\mathcal{R}$ has an equivalence relation on $\mathcal{V}$ known as the indiscernibility relation. Members belonging to the same equivalence class are called to be indiscernible with each other. The pair $(\mathcal{V}, \mathcal{R})$ is called to be the approximation space. Let $\mathcal{X} \subset \mathcal{V}$.

1. The lower approximation of $\mathcal{X}$ with respect to $\mathcal{R}$ is the set of all members, which can be for certain classified as $\mathcal{X}$ with respect to $\mathcal{R}$ and it is represented by $\mathcal{L}_{\mathcal{R}}(\mathcal{X})$. That is,

$\mathcal{L}_{\mathcal{R}}(\mathcal{X}) = \cup_{x \in \mathcal{V}} \{\mathcal{R}(\mathcal{X}) : \mathcal{R}(\mathcal{X}) \subseteq \mathcal{X}\}$,

where $\mathcal{R}(\mathcal{X})$ denoted the equivalence class determined by $\mathcal{X}$.

2. The upper approximation of $\mathcal{X}$ with respect to $\mathcal{R}$ is the set of all members, which can be possibly classified as $\mathcal{X}$ with respect to $\mathcal{R}$ and it is represented by $\mathcal{U}_{\mathcal{R}}(\mathcal{X})$.

(i.e.), $\mathcal{U}_{\mathcal{R}}(\mathcal{X}) = \cup_{x \in \mathcal{V}} \{\mathcal{R}(\mathcal{X}) : \mathcal{R}(\mathcal{X}) \cap \mathcal{X} \neq \phi\}$

3. The boundary region of $\mathcal{X}$ with respect to $\mathcal{R}$ is the set of all members, which can be neither in nor as not $\mathcal{X}$ with respect to $\mathcal{R}$ and it is represented by $\mathcal{B}_{\mathcal{R}}(\mathcal{X})$.

(i.e.), $\mathcal{B}_{\mathcal{R}}(\mathcal{X}) = \mathcal{U}_{\mathcal{R}}(\mathcal{X}) - \mathcal{L}_{\mathcal{R}}(\mathcal{X})$.

Definition 1.2 [3] Let $\mathcal{V}$ be the universe $\mathcal{R}$ be an equivalence relation on $\mathcal{V}$ and $\tau_{\mathcal{R}}(\mathcal{X}) = \{\mathcal{V}, \phi, \mathcal{U}_{\mathrm{R}}(\mathrm{X}), \mathcal{L}_{\mathcal{R}}(\mathcal{X}), \mathcal{B}_{\mathcal{R}}(\mathcal{X})\}$, where $\mathcal{X} \subset \mathcal{V}$. Then $\tau_{\mathcal{R}}(\mathcal{X})$ satisfies the following axioms:

1. $\mathcal{V}$ and $\phi \in \tau_{\mathcal{R}}(\mathcal{X})$.
2. The union of the members of any sub-collection of $\tau_{\mathcal{R}}(\mathcal{X})$ is in $\tau_{\mathcal{R}}(\mathcal{X})$.
3. The intersection of the members of finite sub-collection of $\tau_{\mathcal{R}}(\mathcal{X})$ is in $\tau_{\mathcal{R}}(\mathcal{X})$. That is, $\tau_{\mathcal{R}}(\mathcal{X})$ is a topology on $\mathcal{V}$ is called the nano topology on $\mathcal{V}$ with respect to $\mathcal{X}$. $(\mathcal{V}, \tau_{\mathcal{R}}(\mathcal{X}))$ is called the nano topological space. Members of the nano topology are called nano-open sets in $\mathcal{V}$. Members of $[\tau_{\mathcal{R}}(\mathcal{X})]^c$ are called nano-closed sets.

Definition 1.3 [3] If $(\mathcal{V}, \tau_{\mathcal{R}}(\mathcal{X}))$ is a nano topological space with respect to $\mathcal{X}$, where $\mathcal{X} \subseteq \mathcal{V}$ and if $\mathcal{E} \subseteq \mathcal{V}$, then the nano-interior of E is defined as the union of all nano-open subsets of E and it is denoted by $\mathcal{N}\mathrm{Int}(\mathrm{E})$. (i.e.), $\mathcal{N}\mathrm{Int}(\mathrm{E})$ is the largest nano-open subset of E. The nano-closure of E is defined as the intersection of all nano-closed sets containing E and it is denoted by $\mathcal{N}\mathrm{Cl}(\mathrm{E})$. (i.e.), $\mathcal{N}\mathrm{Cl}(\mathrm{E})$ is the smallest nano-closed set containing E.

Definition 1.4 *Let $(\mathcal{X}, \tau)$ is said to be a topological space.*

1.[1] A subset E of a topological space $(\mathcal{X}, \tau)$ is said to be clopen if it is both closed and open in $(\mathcal{X}, \tau)$.

2.[4] A subset E of a Topological space $(\mathcal{X}, \tau)$, the set $int(\mathcal{X} - E)$ is called exterior of E. (i.e.), the interior of the complement of E.

3.[4] A subset E of a Topological space $(\mathcal{X}, \tau)$, the set $cl(E) - int(E)$ is called boundary of E.

The rest of the paper is designed as follows: In section - 2, gives ζ open sets in nano Topological Spaces with some new results. The conclusion of the present study is set forth in section - 3.

2 ζ open sets in Nano Topological Spaces

In nano topological space, we extend the number of open sets using the same open set which occurs in nano topology and it is called ζ-nano topological space. Then, we discussed its properties of the interior, closure, exterior, and frontier. The relation between them is investigated here.

Definition 2.1 A subset J of a nano topological space $(\mathcal{V}, \mathcal{N}_{\mathcal{R}})$ is called ζ-nano open set if there exists a nano-open set $\mathrm{Z} \in \mathcal{N}_{\mathcal{R}}\text{-}0$, such that

1. $Z \neq \phi, \mathcal{V}$.
2. $J \subseteq \mathcal{N}_{\mathcal{R}}\text{-}int(J) \cup Z$.

Then,the collection of these open set$\mathcal{N}\text{-}\tau_{\zeta}(J)$ is said to be ζ-nano topological space, if it satisfies the following conditions.

1. $\mathcal{V}$ and $\phi \in \mathcal{N}\text{-}\tau_{\zeta}(J)$.
2. The union of the elements of any sub-collection of $\mathcal{N}\text{-}\tau_{\zeta}(J)$ is in $\mathcal{N}\text{-}\tau_{\zeta}(J)$.
3. The intersection of the elements of finite sub-collection of $\mathcal{N}\text{-}\tau_{\zeta}(J)$ is in $\mathcal{N}\text{-}\tau_{\zeta}(J)$.

Now,$\mathcal{N}$-$\tau_\zeta(J)$is called ζ-nano topological space.Then, the member of open set in $\mathcal{N}$-$\tau_\zeta(J)$ is called ζ-nano open and it's complement is ζ-nano closed.We can be rewritten in the form for ζ-nano topological space on $\mathcal{V}$as $(\mathcal{V}, \mathcal{N}_\mathcal{R}, \zeta)$ or $\mathcal{N}$-$\tau_\zeta(J)$.

Note:

1. $\mathcal{N}_\mathcal{R}$-O is a nano-open set.
2. From the definition 2.1, Z is one of the nano-open sets. Either $\mathcal{L}_\mathcal{R}$ or $\mathcal{B}_\mathcal{R}$ or $\mathcal{U}_\mathcal{R}$ are Z. But any of the three open sets should not be a singleton. If one of the three open sets is singleton, then it does not give new open elements.

Remark 2.2 In $(V, \mathcal{N}_\mathcal{R}, \zeta)$, Z is $\mathcal{L}_\mathcal{R}$ but it is singleton. Then we get same set only there does not exists some new open set (i.e,) No extension will occur.

Example 2.3 $V = \{v_1, v_2, v_3, v_4\}$ *with* $V/R = \{\{v_1\}, \{v_3\}, \{v_2, v_4\}\}$ *and* $Y = \{v_1, v_2\} \subset V$. *Nano topology* $\mathcal{N}_\mathcal{R} - \tau(Y) = \{\phi, V, \{v_1\}, \{v_2, v_4\}, \{v_1, v_2, v_4\}\}$.In the definition 2.1,

1. If we choose a singleton open set, $Z_1 = \{v_1\}$, then the family of ζ-nano open set= $\{\phi, V, \{v_1\}, \{v_2, v_4\}, \{v_1, v_2, v_4\}\}$. Finally, we get the same set. There is no extension has occurred.
2. So, we do not choose singleton open set in Nano topology. If $Z_2 = \{v_2, v_4\}$ or $Z_3 = \{v_1, v_2, v_4\}$ then $\mathcal{N}$-$\tau_\zeta(Z_2) = \mathcal{N}$-$\tau_\zeta(Z_3) = \{\phi, V, \{v_1\}, \{v_2\}, \{v_4\}, \{v_1, v_2\}, \{v_1, v_4\}, \{v_2, v_4\},$
$\{v_1, v_2, v_4\}\}$.

Theorem 2.4 In $(V, \mathcal{N}_\mathcal{R}, \zeta)$, if there exists a nano-open set $Z \in \mathcal{N}_\mathcal{R}$-O with $Z \neq \phi, V$ and $J \subseteq \mathcal{N}_\mathcal{R}$-int(J) $\cup$ Z, then it is a topological space.

Proof. Let $\{J_\alpha : \alpha \in \mathcal{I}\}$ be a family of non-empty ζ-nano open set. Now we have to prove $\{J_\alpha : \alpha \in \mathcal{I}\}$ is a topology.

1. Let Z be a ζ-nano open set, if we take $J = \phi$, then $\phi \in \mathcal{N}_\mathcal{R}$-$int(\phi) \cup Z = Z$ by our assumption $Z \in \{J_\alpha : \alpha \in \mathcal{I}\}$ and if we take $J = V$, then $V \in \mathcal{N}_\mathcal{R}$-$int(V) \cup Z = V$ from the definition 2.1 ζ-nano open set $V \in \{J_\alpha : \alpha \in \mathcal{I}\}$.
2. Let $B_i \in \{J_\alpha : \alpha \in \mathcal{I}, i \in \alpha\}$ from de morgan's laws, we get $(\cup_i B_i)^c = \cap_i A_i^c$. Since $B_i \in \{J_\alpha : \alpha \in \mathcal{I}\}$ then $B_i^c \in \{J_\alpha : \alpha \in \mathcal{I}\} \Rightarrow \cap_i B_i^c \in \{J_\alpha : \alpha \in \mathcal{I}\}$. Hence, $\cup_i B_i \in \{J_\alpha : \alpha \in \mathcal{I}\}$.
3. Let $B_i \in \{J_\alpha : \alpha \in \mathcal{I}, i \in \alpha\}, (1 \leq i \leq n)$ then $(\cap_{i=1}^n B_i)^c = \cup_{i=1}^n B_i^c \Rightarrow \cup_{i=1}^n B_i^c \in \{J_\alpha : \alpha \in \mathcal{I}\}$.Thus $\cap_{i=1}^n B_i \in \{J_\alpha : \alpha \in \mathcal{I}\}$.

From 1-3, $\{J_\alpha : \alpha \in \mathcal{I}\}$ is a topological space.

Corollary 2.5 If J be a clopen subset in ζ-nano topological space then ζ-nano topological space is also said to be a topological space.

Proof. The proof is obvious from the definition of clopen set and nano-topological space.

Remark 2.6 In $(V, \mathcal{N}_\mathcal{R}, \zeta)$, if J be a clopen subset, then we do not get the same extension.

Example 2.7 $V = \{v_1, v_2, v_3, v_4, v_5\}$ *with* $V/R = \{\{v_1\}, \{v_2\}, \{v_3, v_4, v_5\}\}$ *and* $Y = \{v_1, v_2, v_3\} \subset V$. Nano topology $\mathcal{N}_\mathcal{R} - \tau(Y) = \{\phi, V, \{v_1, v_2\}, \{v_3, v_4, v_5\}\}$.In the definition of 2.1.

1.If $Z_1 = \{v_1, v_2\}$ then $\mathcal{N} - \tau_\zeta(Z_1) = \{\phi, V, \{v_1\}, \{v_2\}, \{v_1, v_2\}, \{v_3, v_4, v_5\},$
$\{v_1, v_3, v_4, v_5\}, \{v_2, v_3, v_4, v_5\}\}$.

2.If $Z_2 = \{v_3, v_4, v_5\}$ then $\mathcal{N} - \tau_\zeta(Z_2) = \{\phi, V, \{v_3\}, \{v_4\}, \{v_5\}, \{v_1, v_2\}, \{v_3, v_4\},$
$\{v_3, v_5\}, \{v_4, v_5\}, \{v_1, v_2, v_3\}, \{v_1, v_2, v_4\}, \{v_1, v_2, v_5\}, \{v_3, v_4, v_5\}, \{v_1, v_2, v_3, v_4\}, \{v_1, v_2, v_3, v_5\},$
$\{v_1, v_2, v_4, v_5\}\}$.

Definition 2.8 Let E be a subset of a ζ-nano topology.

1. The union of all ζ-nano open sets contained in E is represent in the form of ζ-nano-int(E). We can rewrite in the form $\zeta_\mathcal{N}$-i-(E).
2. The intersection of all ζ-nano closed sets containing in E is represent in the form of ζ-nano-cl(E). Also we write in the form $\zeta_\mathcal{N}$-c-(E).

3. The exterior of ζ-nano topology in E is defined by $\zeta_{\mathcal{N}}$-e-$(E) = \zeta_{\mathcal{N}}$-$i$-$(V - E)$.
4. The frontier of ζ-nano topology in E is defined by $\zeta_{\mathcal{N}}$-f-$(E) = \zeta_{\mathcal{N}}$-$c$-$(E) \cap \zeta_{\mathcal{N}}$-$c$-$(V - E)$.

Proposition 2.9 In $(V, \mathcal{N}_{\mathcal{R}}, \zeta)$, if E and F are subsets, then the following should be attained.
1. $\zeta_{\mathcal{N}}$-i-$(\phi) = \phi$ and $\zeta_{\mathcal{N}}$-c-$(\phi) = \phi$.
2. $\zeta_{\mathcal{N}}$-i-$(V) = V$ and $\zeta_{\mathcal{N}}$-c-$(V) = V$.
3. $\zeta_{\mathcal{N}}$-i-$(E) \subseteq E \subseteq \zeta_{\mathcal{N}}$-$c$-$(E)$.
4. $E \subseteq F \Rightarrow \zeta_{\mathcal{N}}$-$i$-$(E) \subseteq \zeta_{\mathcal{N}}$-$i$-$(F)$ and $\zeta_{\mathcal{N}}$-c-$(E) \subseteq \zeta_{\mathcal{N}}$-$i$-$(F)$.
5. $\zeta_{\mathcal{N}}$-i-$(E \cap F) \subseteq \zeta_{\mathcal{N}}$-$i$-$(E) \cap \zeta_{\mathcal{N}}$-$i$-$(F)$.
6. $\zeta_{\mathcal{N}}$-c-$(E \cap F) = \zeta_{\mathcal{N}}$-$c$-$(E) \cap \zeta_{\mathcal{N}}$-$c$-$(F)$.
7. $\zeta_{\mathcal{N}}$-c-$(E \cup F) \supseteq \zeta_{\mathcal{N}}$-$c$-$(E) \cup \zeta_{\mathcal{N}}$-$c$-$(F)$.
8. $\zeta_{\mathcal{N}}$-i-$(E \cup F) = \zeta_{\mathcal{N}}$-$i$-$(E) \cup \zeta_{\mathcal{N}}$-$i$-$(F)$.
9. $\zeta_{\mathcal{N}}$-i-$(\zeta_{\mathcal{N}}$-i-$(E)) \subseteq \zeta_{\mathcal{N}}$-$i$-$(E)$.
10. $\zeta_{\mathcal{N}}$-c-$(\zeta_{\mathcal{N}}$-c-$(E)) \supseteq \zeta_{\mathcal{N}}$-$c$-$(E)$.
11. $\zeta_{\mathcal{N}}$-i-$(E) = E = \zeta_{\mathcal{N}}$-$c$-$(E)$.

Proof. (1) - (4) easily follows from the definition of 2.8 (1) and (2). Since $E \cap F \subseteq E$ and $E \cap F \subseteq F$, by using (4) $\zeta_{\mathcal{N}}$-i-(E ∩ F) ⊆ $\zeta_{\mathcal{N}}$-i-(E) and $\zeta_{\mathcal{N}}$-i-(E ∩ F) ⊆ $\zeta_{\mathcal{N}}$-i-(F) which implies that $\zeta_{\mathcal{N}}$-i-(E ∩ F) ⊆ $\zeta_{\mathcal{N}}$-i-(E) ∩ $\zeta_{\mathcal{N}}$-i-(F). Hence, (5) is proved.

Similarly for the ζ-nano closure condition: We know that(W.K.T) $E \cap F \subseteq E$ and $E \cap F \subseteq F$, then from (3)$\zeta_{\mathcal{N}}$-c-$(E \cap F) \subseteq \zeta_{\mathcal{N}}$-$c$-$(E), \zeta_{\mathcal{N}}$-$c$-$(E \cap F) \subseteq \zeta_{\mathcal{N}}$-$c$-$(F)$. Hence, $\zeta_{\mathcal{N}}$-c-$(E \cap F) \subseteq \zeta_{\mathcal{N}}$-$c$-$(E) \cap \zeta_{\mathcal{N}}$-$c$-$(F)$. The first part of (6) is proved. To prove that the second part of (6), $\zeta_{\mathcal{N}}$-c-$(E) \cap \zeta_{\mathcal{N}}$-$c$-$(F) \subseteq \zeta_{\mathcal{N}}$-$c$-$(E \cap F)$. Let $x \in \zeta_{\mathcal{N}}$-$c$-$(E) \cap \zeta_{\mathcal{N}}$-$c$-$(F) \Rightarrow x \in \zeta_{\mathcal{N}}$-$c$-$(E)$ and $x \in \zeta_{\mathcal{N}}$-$c$-$(F) \Rightarrow x \subseteq E$ and $x \subseteq F \Rightarrow x \subseteq E \cap F \Rightarrow x \in \zeta_{\mathcal{N}}$-$c$-$(E \cap F)$. So that $\zeta_{\mathcal{N}}$-c-$(E) \cap \zeta_{\mathcal{N}}$-$c$-$(F) \subseteq \zeta_{\mathcal{N}}$-$c$-$(P \cap Q)$. Therefore, $\zeta_{\mathcal{N}}$-c-$(E \cap F) = \zeta_{\mathcal{N}}$-$c$-$(E) \cap \zeta_{\mathcal{N}}$-$c$-$(F)$. The second part of (6) is proved. Thus (6) is proved.
Again, Since $E \cup F \supseteq E$ and $E \cup F \supseteq F$, by using (4) $\zeta_{\mathcal{N}}$-c-$(E \cup F) \supseteq \zeta_{\mathcal{N}}$-$c$-$(E)$ and $\zeta_{\mathcal{N}}$-c-$(E \cup F) \supseteq \zeta_{\mathcal{N}}$-$c$-$(F)$ which gives $\zeta_{\mathcal{N}}$-c-$(E \cup F) \supseteq \zeta_{\mathcal{N}}$-$c$-$(E) \cup \zeta_{\mathcal{N}}$-$c$-$(F)$. Thence, (7) is proved.
Similarly, for the ζ-nano-interior condition: W.K.T $E \subseteq E \cup F$ and $F \subseteq E \cup F$, then from (3)$\zeta_{\mathcal{N}}$-i-$(E) \subseteq \zeta_{\mathcal{N}}$-$i$-$(E \cup F)$ and $\zeta_{\mathcal{N}}$-i-$(F) \subseteq \zeta_{\mathcal{N}}$-$i$-$(E \cup F)$. Consequently, $\zeta_{\mathcal{N}}$-i-$(E) \cup \zeta_{\mathcal{N}}$-$i$-$(F) \subseteq \zeta_{\mathcal{N}}$-$i$-$(E \cup F)$. The another part of (8) is to prove that $\zeta_{\mathcal{N}}$-i-$(E \cup F) \subseteq \zeta_{\mathcal{N}}$-$i$-$(E) \cup \zeta_{\mathcal{N}}$-$i$-$(F)$. Let $x \in \zeta_{\mathcal{N}}$-$i$-$(E \cup F) \Rightarrow x \subseteq E \cup F \Rightarrow x \subseteq E$ or $x \subseteq F \Rightarrow x \in \zeta_{\mathcal{N}}$-$i$-$(E)$ or $x \in \zeta_{\mathcal{N}}$-$i$-$(F) \Rightarrow x \in \zeta_{\mathcal{N}}$-$i$-$(E) \cup x \in \zeta_{\mathcal{N}}$-$i$-$(F)$. So that $\zeta_{\mathcal{N}}$-i-$(E \cup F) \subseteq \zeta_{\mathcal{N}}$-$i$-$(E) \cup \zeta_{\mathcal{N}}$-$i$-$(F)$.Consequently, $\zeta_{\mathcal{N}}$-i-$(E) \cup \zeta_{\mathcal{N}}$-$i$-$(F) = \zeta_{\mathcal{N}}$-$i$-$(P \cup Q)$. Hence, (8) is proved.
From (4), $\zeta_{\mathcal{N}}$-i-$(E) \subseteq E$, $\zeta_{\mathcal{N}}$-c-$(E) \supseteq E$ and $\zeta_{\mathcal{N}}$-i-$(E) \subseteq \zeta_{\mathcal{N}}$-$c$-$(E)$ which gives $\zeta_{\mathcal{N}}$-i-$(\zeta_{\mathcal{N}}$-i-$(E)) \subseteq \zeta_{\mathcal{N}}$-$i$-$(E)$ and $\zeta_{\mathcal{N}}$-c-$(\zeta_{\mathcal{N}}$-c-$(E)) \supseteq \zeta_{\mathcal{N}}$-$c$-$(E)$. Thus, (9) and (10) are proved.
From (3), $\zeta_{\mathcal{N}}$-i-$(E) \subseteq E \subseteq \zeta_{\mathcal{N}}$-$c$-$(E)$. Since $\zeta_{\mathcal{N}}$-i-$(E) = \cup \{J: J \subseteq E$, J be a subset of $\mathcal{N}$-$\tau_{\zeta}(V)\}$.W.K.T E is also $\mathcal{N}$-$\tau_{\zeta}(V)$, which gives that $E \subseteq \zeta_{\mathcal{N}}$-$i$-$(E)$ then $E = \zeta_{\mathcal{N}}$-i-(E). Since $\zeta_{\mathcal{N}}$-c-$(E) = \cap \{J: J \supseteq E$, J be a subset of $\mathcal{N}$-$\tau_{\zeta}(V)\}$. Again W.K.T E is also belongs to $\mathcal{N}$-$\tau_{\zeta}(V)$, which gives $E \supseteq \zeta_{\mathcal{N}}$-$c$-$(E)$, then $E = \zeta_{\mathcal{N}}$-c-(E). Thence, (11) is proved.

Theorem 2.10 In $(V, \mathcal{N}_{\mathcal{R}}, \zeta)$, for any subset E ⊆ V, V − $\zeta_{\mathcal{N}}$-i-(E) = $\zeta_{\mathcal{N}}$-c-(V − E).

Proof. We take V − $\zeta_{\mathcal{N}}$-i-(E) = V − ∪ {J: J ⊆ E, J be a $\mathcal{N}$-τ_{ζ}(V) in V} = ∩ {V − J: J ⊆ E, J be a $\mathcal{N}$-τ_{ζ}(V) in V} = ∩ {V − J: V − J ⊇ V − E, J be a $\mathcal{N}$-τ_{ζ}(V) in V} = ∩ {V − J: V − J ⊇ V − E, V − J be a $\mathcal{N}$-τ_{ζ}(V) in V} = ∩ {J: J ⊇ V − E, J be a $\mathcal{N}$-τ_{ζ}(V) in V} = $\zeta_{\mathcal{N}}$-c-(V − E). Therefore, V − $\zeta_{\mathcal{N}}$-i-(E) = $\zeta_{\mathcal{N}}$-c-(V − E).

Corollary 2.11 $V - \zeta_{\mathcal{N}}$-c-$(E) = \zeta_{\mathcal{N}}$-$i$-$(V - E)$.

Proof. Here, V − $\zeta_{\mathcal{N}}$-c-(E) = V − ∩ {J: J ⊇ E, J be a $\mathcal{N}$-τ_{ζ}(V) in V} = ∪ {V − J: J ⊇ E, J be a $\mathcal{N}$-τ_{ζ}(V) in V} = ∪ {V − J: V − J ⊆ V − E, J be a $\mathcal{N}$-τ_{ζ}(V) in V} = ∪ {V − J: V − J ⊆ V − E, V − J be a $\mathcal{N}$-τ_{ζ}(V) in V} = ∪ {J: J ⊆ V − E, J be a $\mathcal{N}$-τ_{ζ}(V) in V} = $\zeta_{\mathcal{N}}$-i-(V − E). Consequently, V − $\zeta_{\mathcal{N}}$-c-(E) = $\zeta_{\mathcal{N}}$-i-(V − E).

Lemma 2.12 If E and F are subsets of a ζ-nano topological space, then $\zeta_{\mathcal{N}}\text{-i-}(E) - \zeta_{\mathcal{N}}\text{-c-}(F) = \zeta_{\mathcal{N}}\text{-i-}(E - F)$.

Proof. From the corollary 2.11, we take $\zeta_{\mathcal{N}}\text{-i-}(E) - \zeta_{\mathcal{N}}\text{-c-}(F) = \zeta_{\mathcal{N}}\text{-i-}(E) \cap (V - \zeta_{\mathcal{N}}\text{-c-}(F)) = \zeta_{\mathcal{N}}\text{-i-}(E \cap (V - \zeta_{\mathcal{N}}\text{-c-}(F))) = \zeta_{\mathcal{N}}\text{-i-}(E - F)$.

Theorem 2.13 If E and F are subsets of a ζ-nano topological space, then
1. $V - \zeta_{\mathcal{N}}\text{-c-}(E) - \zeta_{\mathcal{N}}\text{-i-}(F) = V - \zeta_{\mathcal{N}}\text{-c-}(E - F)$.
2. $\zeta_{\mathcal{N}}\text{-i-}((V - E) \cup F) = \zeta_{\mathcal{N}}\text{-i-}(V - E) \cup \zeta_{\mathcal{N}}\text{-i-}(F)$.

Proof. If E and F are subsets then we take (1), $V - \zeta_{\mathcal{N}}\text{-c-}(E - F) = V - \zeta_{\mathcal{N}}\text{-c-}(E \cap V - F) = \zeta_{\mathcal{N}}\text{-i-}(V - (E \cap V - F)) = \zeta_{\mathcal{N}}\text{-i-}((V - E) \cup F) = \zeta_{\mathcal{N}}\text{-i-}(V - E) \cup \zeta_{\mathcal{N}}\text{-i-}(F) = V - \zeta_{\mathcal{N}}\text{-i-}(E) \cup \zeta_{\mathcal{N}}\text{-i-}(F) = (V - \zeta_{\mathcal{N}}\text{-i-}(E)) \cup (V - (V - \zeta_{\mathcal{N}}\text{-i-}(F))) = (V - (\zeta_{\mathcal{N}}\text{-c-}(E)) \cap (V - \zeta_{\mathcal{N}}\text{-i-}(F))) = V - \zeta_{\mathcal{N}}\text{-c-}(E) - \zeta_{\mathcal{N}}\text{-i-}(F)$. Thence $V - \zeta_{\mathcal{N}}\text{-c-}(E) - \zeta_{\mathcal{N}}\text{-i-}(F) = V - \zeta_{\mathcal{N}}\text{-c-}(E - F)$. From the corollary 2.11 and the left hand side of (1) is $V - \zeta_{\mathcal{N}}\text{-c-}(E) - \zeta_{\mathcal{N}}\text{-i-}(F) = V - (\zeta_{\mathcal{N}}\text{-c-}(E) \cap (V - \zeta_{\mathcal{N}}\text{-i-}(F))) = (V - \zeta_{\mathcal{N}}\text{-c-}(E)) \cup \zeta_{\mathcal{N}}\text{-i-}(F) = \zeta_{\mathcal{N}}\text{-i-}(V - E) \cup \zeta_{\mathcal{N}}\text{-i-}(F)$. Also consider right hand side of (1) is $V - \zeta_{\mathcal{N}}\text{-c-}(E - F) = \zeta_{\mathcal{N}}\text{-i-}(V - (E - F)) = \zeta_{\mathcal{N}}\text{-i-}(V - (E \cap (V - F))) = \zeta_{\mathcal{N}}\text{-i-}((V - E) \cup F)$. Therefore, we conclude that the condition (ii) is satisfied.

Proposition 2.14 In $(V, \mathcal{N}_{\mathcal{R}}, \zeta)$, if E and F are subsets, then the following should be attained.
1. $\zeta_{\mathcal{N}}\text{-e-}(E) = V - \zeta_{\mathcal{N}}\text{-c-}(E)$.
2. $\zeta_{\mathcal{N}}\text{-e-}(V) = \phi$.
3. $\zeta_{\mathcal{N}}\text{-e-}(\phi) = V$.
4. $E \cap \zeta_{\mathcal{N}}\text{-e-}(E) = \phi$.
5. $E \subseteq F \Rightarrow \zeta_{\mathcal{N}}\text{-e-}(E) \supseteq \zeta_{\mathcal{N}}\text{-e-}(F)$.
6. $\zeta_{\mathcal{N}}\text{-e-}(E \cup F) \subseteq \zeta_{\mathcal{N}}\text{-e-}(E) \cap \zeta_{\mathcal{N}}\text{-e-}(F)$.
7. If E is $\zeta_{\mathcal{N}}$-O, $\zeta_{\mathcal{N}}\text{-e-}(E) = V - E$.

Proof. From the definition 2.8 (3) and corollary 2.11, we get $\zeta_{\mathcal{N}}\text{-e-}(E) = \zeta_{\mathcal{N}}\text{-i-}(V - E) = V - \zeta_{\mathcal{N}}\text{-c-}(E)$. Hence, $\zeta_{\mathcal{N}}\text{-e-}(E) = V - \zeta_{\mathcal{N}}\text{-c-}(E)$. Therefore, (i) is proved. Again from the definition 2.8 (3), $\zeta_{\mathcal{N}}\text{-e-}(V) = \zeta_{\mathcal{N}}\text{-i-}(V - V) = \zeta_{\mathcal{N}}\text{-i-}(\phi) = \phi$ by using the proposition 2.9(1). Hence, $\zeta_{\mathcal{N}}\text{-e-}(V) = \phi$. Thus, (2) is proved. Again, from the definition 2.8 (3) and proposition 2.9(2), $\zeta_{\mathcal{N}}\text{-e-}(\phi) = \zeta_{\mathcal{N}}\text{-i-}(V - \phi) = \zeta_{\mathcal{N}}\text{-i-}(V) = V$. Hence, $\zeta_{\mathcal{N}}\text{-e-}(\phi) = V$. Thence, (3) is proved. $E \cap \zeta_{\mathcal{N}}\text{-e-}(E) = E \cap \zeta_{\mathcal{N}}\text{-i-}(V - E) = E \cap (V - E) = \phi$. Thus (4) is proved. Now $E \subseteq F \Rightarrow (V - E) \supseteq (V - F) \Rightarrow \zeta_{\mathcal{N}}\text{-i-}(V - E) \supseteq \zeta_{\mathcal{N}}\text{-i-}(V - F)$. This gives $\zeta_{\mathcal{N}}\text{-e-}(E) \supseteq \zeta_{\mathcal{N}}\text{-e-}(F)$. Thus, (5) is proved. Now $\zeta_{\mathcal{N}}\text{-e-}(E \cup F) = \zeta_{\mathcal{N}}\text{-i-}(V - (E \cup F)) = \zeta_{\mathcal{N}}\text{-i-}((V - E) \cap (V - F))$. By the proposition 2.9(v), $\zeta_{\mathcal{N}}\text{-i-}((V - E) \cap (V - F)) = \zeta_{\mathcal{N}}\text{-i-}(V - E) \cap \zeta_{\mathcal{N}}\text{-i-}(V - F)$. Hence, $\zeta_{\mathcal{N}}\text{-e-}(E \cup F) \subseteq \zeta_{\mathcal{N}}\text{-i-}(V - E) \cap \zeta_{\mathcal{N}}\text{-i-}(V - F) = \zeta_{\mathcal{N}}\text{-e-}(E) \cap \zeta_{\mathcal{N}}\text{-e-}(F)$. Thus, (6) is proved. From the definition 2.8 (3), let E is $\zeta_{\mathcal{N}}$-O, $\zeta_{\mathcal{N}}\text{-e-}(E) = \zeta_{\mathcal{N}}\text{-i-}(V - E) = V - E$ by using the proposition 2.9(i). Hence, $\zeta_{\mathcal{N}}\text{-e-}(E) = V - E$. Thus, (vii) is proved.

Proposition 2.15 In $(V, \mathcal{N}_{\mathcal{R}}, \zeta)$, if E is a subset, then the following should be attained.
1. $\zeta_{\mathcal{N}}\text{-f-}(E) = \zeta_{\mathcal{N}}\text{-f-}(V - E)$.
2. $\zeta_{\mathcal{N}}\text{-f-}(E) = \zeta_{\mathcal{N}}\text{-c-}(E) - \zeta_{\mathcal{N}}\text{-i-}(E)$.
3. $\zeta_{\mathcal{N}}\text{-c-}(E) = \zeta_{\mathcal{N}}\text{-i-}(E) \cup \zeta_{\mathcal{N}}\text{-f-}(E)$.
4. $\zeta_{\mathcal{N}}\text{-c-}(E) = E \cup \zeta_{\mathcal{N}}\text{-f-}(E)$.
5. If E is $\zeta_{\mathcal{N}}$-O, $\zeta_{\mathcal{N}}\text{-f-}(E) = \phi$.

Proof. From the definition 2.8 (4), $\zeta_{\mathcal{N}}\text{-f-}(V - E) = \zeta_{\mathcal{N}}\text{-c-}(V - E) \cap \zeta_{\mathcal{N}}\text{-c-}(V - (V - E)) = \zeta_{\mathcal{N}}\text{-c-}(E) \cap \zeta_{\mathcal{N}}\text{-c-}(V - E) = \zeta_{\mathcal{N}}\text{-f-}(E)$. Thus, (1) is proved. Let $\zeta_{\mathcal{N}}\text{-f-}(E) = \zeta_{\mathcal{N}}\text{-c-}(E) \cap \zeta_{\mathcal{N}}\text{-c-}(V - E)$ follows from the definition 2.8 (4). By proposition 2.10, $\zeta_{\mathcal{N}}\text{-c-}(V - E) = V - \zeta_{\mathcal{N}}\text{-i-}(E)$. Therefore, $\zeta_{\mathcal{N}}\text{-f-}(E) = \zeta_{\mathcal{N}}\text{-c-}(E) \cap (V - \zeta_{\mathcal{N}}\text{-i-}(E)) = \zeta_{\mathcal{N}}\text{-c-}(E) - (V - (V - \zeta_{\mathcal{N}}\text{-i-}(E))) = \zeta_{\mathcal{N}}\text{-c-}(E) - \zeta_{\mathcal{N}}\text{-i-}(E)$. Thence, (2) is proved. $\zeta_{\mathcal{N}}\text{-c-}(E) = \zeta_{\mathcal{N}}\text{-i-}(E) \cup (\zeta_{\mathcal{N}}\text{-c-}E) - \zeta_{\mathcal{N}}\text{-i-}(E)) = \zeta_{\mathcal{N}}\text{-i-}(E) \cup \zeta_{\mathcal{N}}\text{-f-}(E)$. Hence, (3) is proved. Assume that $\zeta_{\mathcal{N}}\text{-c-}(E) = E$ in $(V, \mathcal{N}_{\mathcal{R}}, \zeta)$. From the definition 2.8 (4), $\zeta_{\mathcal{N}}\text{-f-}(E) = \zeta_{\mathcal{N}}\text{-c-}(E) \cap \zeta_{\mathcal{N}}\text{-c-}(V - E) = E \cap (V - E)$. Thus, $\zeta_{\mathcal{N}}\text{-f-}(E) = E \cap (V - E) = \phi$. Consequently, (4) is proved.

Let $\zeta_{\mathcal{N}}\text{-f-}(E) = \zeta_{\mathcal{N}}\text{-c-}(E) \cap \zeta_{\mathcal{N}}\text{-c-}(V - E)$ follows from the definition 2.8 (4). By definition 2.1, $\zeta_{\mathcal{N}}\text{-c-}(E) = E$ and $\zeta_{\mathcal{N}}\text{-c-}(V - E) = V - E$. Thus $\zeta_{\mathcal{N}}\text{-f-}(E) = E \cap V - E = \phi$. Thus, (5) is proved.

Theorem 2.16 In $(V, \mathcal{N}_{\mathcal{R}}, \zeta)$, if E is a subset, then the following should be attained.
1. $\zeta_{\mathcal{N}}\text{-i-}(E) \cap \zeta_{\mathcal{N}}\text{-e-}(E) \cap \zeta_{\mathcal{N}}\text{-f-}(E) = \phi$.
2. $\zeta_{\mathcal{N}}\text{-i-}(E) \cup \zeta_{\mathcal{N}}\text{-e-}(E) \cup \zeta_{\mathcal{N}}\text{-f-}(E) = V$.

Proof. Consider, $\zeta_{\mathcal{N}}\text{-i-}(E) \cap \zeta_{\mathcal{N}}\text{-e-}(E) \cap \zeta_{\mathcal{N}}\text{-f-}(E) = \zeta_{\mathcal{N}}\text{-i-}(E) \cap \zeta_{\mathcal{N}}\text{-i-}(V - E) \cap \zeta_{\mathcal{N}}\text{-c-}(E) \cap \zeta_{\mathcal{N}}\text{-c-}(V - E) \subseteq \zeta_{\mathcal{N}}\text{-i-}(E) \cap \zeta_{\mathcal{N}}\text{-i-}(V - E) \subseteq E \cap V - E = \phi$ by the definition 2.8 (1), (3) and (4). Hence, $\zeta_{\mathcal{N}}\text{-i-}(E) \cap \zeta_{\mathcal{N}}\text{-e-}(E) \cap \zeta_{\mathcal{N}}\text{-f-}(E) = \phi$. By the proposition 2.14 (1) and 2.15 (2), $\zeta_{\mathcal{N}}\text{-i-}(E) \cup \zeta_{\mathcal{N}}\text{-e-}(E) \cup \zeta_{\mathcal{N}}\text{-f-}(E) = \zeta_{\mathcal{N}}\text{-i-}(E) \cup (V - \zeta_{\mathcal{N}}\text{-c-}(E)) \cup (\zeta_{\mathcal{N}}\text{-c-}(E) - \zeta_{\mathcal{N}}\text{-i-}(E)) = L$. We claim that $L = V$, Suppose $v \in V$. If $v \in V - \zeta_{\mathcal{N}}\text{-c-}(E)$ then $v \in L$. If $v \notin V - \zeta_{\mathcal{N}}\text{-c-}(E)$ then $v \in \zeta_{\mathcal{N}}\text{-c-}(E)$, so that $v \in \zeta_{\mathcal{N}}\text{-c-}(E) - \zeta_{\mathcal{N}}\text{-i-}(E)$. This gives $v \in L$. If $v \notin \zeta_{\mathcal{N}}\text{-c-}(E) - \zeta_{\mathcal{N}}\text{-i-}(E)$ then $v \in \zeta_{\mathcal{N}}\text{-i-}(E)$ that gives $v \in L$. Hence, $V = \zeta_{\mathcal{N}}\text{-i-}(E) \cup \zeta_{\mathcal{N}}\text{-e-}(E) \cup \zeta_{\mathcal{N}}\text{-f-}(E)$.

Theorem 2.17 If E and F are subsets in ζ-nano topological space, then
1. $\zeta_{\mathcal{N}}\text{-f-}(E \cup F) = (\zeta_{\mathcal{N}}\text{-f-}(E) - \zeta_{\mathcal{N}}\text{-i-}(F)) \cup (\zeta_{\mathcal{N}}\text{-f-}(F) - \zeta_{\mathcal{N}}\text{-i-}(E))$.
2. $\zeta_{\mathcal{N}}\text{-f-}(E \cap F) = (\zeta_{\mathcal{N}}\text{-f-}(E) \cup \zeta_{\mathcal{N}}\text{-i-}(F)) \cap (\zeta_{\mathcal{N}}\text{-c-}(E) \cap \zeta_{\mathcal{N}}\text{-c-}(F))$.

Proof.1.Let $\zeta_{\mathcal{N}}\text{-f-}(E \cup F) = \zeta_{\mathcal{N}}\text{-c-}(E \cup F) \cap \zeta_{\mathcal{N}}\text{-c-}(V - (E \cup F)) = (\zeta_{\mathcal{N}}\text{-c-}(E) \cup \zeta_{\mathcal{N}}\text{-c-}(F)) \cap (V - \zeta_{\mathcal{N}}\text{-i-}(E \cup F)) = (\zeta_{\mathcal{N}}\text{-c-}(E) \cup \zeta_{\mathcal{N}}\text{-c-}(F)) \cap (V - (\zeta_{\mathcal{N}}\text{-i-}(E) \cup \zeta_{\mathcal{N}}\text{-i-}(F))) = (\zeta_{\mathcal{N}}\text{-c-}(E) \cup \zeta_{\mathcal{N}}\text{-c-}(F)) \cap ((V - \zeta_{\mathcal{N}}\text{-i-}(E)) \cup (V - \zeta_{\mathcal{N}}\text{-i-}(F))) = (\zeta_{\mathcal{N}}\text{-c-}(E) \cap (V - \zeta_{\mathcal{N}}\text{-i-}(E)) \cup (V - \zeta_{\mathcal{N}}\text{-i-}(F))) \cup (\zeta_{\mathcal{N}}\text{-c-}(F) \cap (V - \zeta_{\mathcal{N}}\text{-i-}(E)) \cup (V - \zeta_{\mathcal{N}}\text{-i-}(F))) = ((\zeta_{\mathcal{N}}\text{-c-}(E) - \zeta_{\mathcal{N}}\text{-i-}(E)) \cap (V - \zeta_{\mathcal{N}}\text{-i-}(F))) \cup ((\zeta_{\mathcal{N}}\text{-c-}(F) - \zeta_{\mathcal{N}}\text{-i-}(F)) \cap (V - \zeta_{\mathcal{N}}\text{-i-}(E))) = (\zeta_{\mathcal{N}}\text{-f-}(E) - \zeta_{\mathcal{N}}\text{-i-}(F)) \cup (\zeta_{\mathcal{N}}\text{-f-}(F) - \zeta_{\mathcal{N}}\text{-i-}(E))$. Thus, (1) is proved.
2.Consider $\zeta_{\mathcal{N}}\text{-}f\text{-}(E \cap F) = \zeta_{\mathcal{N}}\text{-}c\text{-}(E \cap F) \cap \zeta_{\mathcal{N}}\text{-}c\text{-}(V - (E \cap F)) = (\zeta_{\mathcal{N}}\text{-}c\text{-}(E) \cap \zeta_{\mathcal{N}}\text{-}c\text{-}(F)) \cap (V - \zeta_{\mathcal{N}}\text{-}i\text{-}(E \cap F)) = (\zeta_{\mathcal{N}}\text{-}c\text{-}(E) \cap \zeta_{\mathcal{N}}\text{-}c\text{-}(F)) \cap (V - (\zeta_{\mathcal{N}}\text{-}i\text{-}(E) \cap \zeta_{\mathcal{N}}\text{-}i\text{-}(F))) = (\zeta_{\mathcal{N}}\text{-}c\text{-}(E) \cap \zeta_{\mathcal{N}}\text{-}c\text{-}(F)) \cap ((V - \zeta_{\mathcal{N}}\text{-}i\text{-}(E)) \cup (V - \zeta_{\mathcal{N}}\text{-}i\text{-}(F))) = ((\zeta_{\mathcal{N}}\text{-}c\text{-}(E) \cap \zeta_{\mathcal{N}}\text{-}c\text{-}(F)) \cap (V - \zeta_{\mathcal{N}}\text{-}i\text{-}(E))) \cup ((\zeta_{\mathcal{N}}\text{-}c\text{-}(E) \cap \zeta_{\mathcal{N}}\text{-}c\text{-}(F)) \cap (V - \zeta_{\mathcal{N}}\text{-}i\text{-}(F))) = ((\zeta_{\mathcal{N}}\text{-}c\text{-}(E) - \zeta_{\mathcal{N}}\text{-}i\text{-}(E)) \cap \zeta_{\mathcal{N}}\text{-}c\text{-}(F)) \cup (\zeta_{\mathcal{N}}\text{-}c\text{-}(E) \cap (\zeta_{\mathcal{N}}\text{-}c\text{-}(F) - \zeta_{\mathcal{N}}\text{-}i\text{-}(F))) = (\zeta_{\mathcal{N}}\text{-}f\text{-}(E) \cap \zeta_{\mathcal{N}}\text{-}c\text{-}(F)) \cup (\zeta_{\mathcal{N}}\text{-}c\text{-}(E) \cap \zeta_{\mathcal{N}}\text{-}f\text{-}(F)) = (\zeta_{\mathcal{N}}\text{-}f\text{-}(E) \cup \zeta_{\mathcal{N}}\text{-}c\text{-}(E)) \cap (\zeta_{\mathcal{N}}\text{-}f\text{-}(E) \cup \zeta_{\mathcal{N}}\text{-}f\text{-}(F)) \cap (\zeta_{\mathcal{N}}\text{-}c\text{-}(E) \cup \zeta_{\mathcal{N}}\text{-}c\text{-}(F)) \cap (\zeta_{\mathcal{N}}\text{-}c\text{-}(F) \cup \zeta_{\mathcal{N}}\text{-}f\text{-}(F)) = \zeta_{\mathcal{N}}\text{-}c\text{-}(E) \cap (\zeta_{\mathcal{N}}\text{-}f\text{-}(E) \cup \zeta_{\mathcal{N}}\text{-}f\text{-}(F)) \cap (\zeta_{\mathcal{N}}\text{-}c\text{-}(E) \cup \zeta_{\mathcal{N}}\text{-}c\text{-}(F)) \cap \zeta_{\mathcal{N}}\text{-}c\text{-}(F) = (\zeta_{\mathcal{N}}\text{-}f\text{-}(E) \cup \zeta_{\mathcal{N}}\text{-}i\text{-}(F)) \cap (\zeta_{\mathcal{N}}\text{-}c\text{-}(E) \cap \zeta_{\mathcal{N}}\text{-}c\text{-}(F))$. Hence, (2) is proved.

CONCLUSION

In this paper, we can extended the nano topology using $\mathcal{L}_{\mathcal{R}}$, $\mathcal{U}_{\mathcal{R}}$, and $\mathcal{B}_{\mathcal{R}}$ is called ζ-nano topology. In future, We can develop in the generalized closed sets, neighbourhood, limit point, and derived sets using $\mathcal{L}_{\mathcal{R}}$, $\mathcal{U}_{\mathcal{R}}$, and $\mathcal{B}_{\mathcal{R}}$.Also, we shall extend in ideal nano topology, fuzzy nano topology, grill nano topology, bi nano topology, neutrosophic nano topology, graph structures in nano topology, etc with some of the applications.

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RESEARCH ARTICLE

Design and Optimization of Solid Lipid Nanoparticles Based Gel of Tazarotene for Topical Delivery

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ABSTRACT

Solid lipid nanoparticles were used as drug carriers for lipophilic drugs to facilitate the drug release of water-insoluble drugs. Tazarotene was successfully entrapped in lipid Glyceryl Monostearate (GMS), Tween 80 was used as a surfactant and Poloxamer 188 was used as a stabilizer for solid lipid nanoparticles. Tazarotene is useful in treating psoriasis topically. The Box Behnken design showed optimized result at 7.5 minute sonication time, 500 mg stabilizer concentration and 1 mg lipid concentration. It was seen that particle size 30.71 nm, entrapment efficiency 82.89% and in vitro drug release72.87% of batch F7. The hot homogenization method was beneficial for the successful incorporation of the poorly-soluble drug Tazarotene with high entrapment efficiency. The pH of optimized SLN formulation was found to be 5.2. Zeta potential of optimized formulation was -50 mV indicated the potential stability of the prepared colloidal system. The optimized Lyophilized powder of SLN formulation dispersed in carbopol P 934 gel and evaluated. The physical appearance of formulation was found to be smooth, transparent and homogeneous pH (5.8) Viscosity (2618±52.12 cps), Spreadability (6.18±0.05gm in 60 sec).

Keywords: Tazarotene, Solid Lipid Nanoparticles, Topically, Psoriasis, Entrapment Efficiency, Lyophilized, Zeta potential.

INTRODUCTION

Solid Lipid Nanoparticles (SLN) are colloidal lipid carriers that are solid at room and body temperature. They were originally described in 1991. SLN are the spherical shaped structures with size ranging from 50 nm to 1000 nm [1].SLN are made from non-toxic GRAS (generally regarded as safe) lipids and surfactants. In parenteral (intravenously, intramuscularly, or hypodermically) oral and rectal treatments, ophthalmology, and exterior applications, SLN have been used to regulate medication release and increase the bioavailability of trapped active ingredient by altering the dissolving rate (dermatology, cosmetics). Because of their various benefits over traditional forms, SLN are regarded potential carriers for active cosmetic compounds [2]. Psoriasis is a skin and joint inflammatory disease that is autoimmune and non-communicable. The name "psoriasis" is derived from the Greek word "psora," which meaning "skin, "Itchy, and "iasis" refers to a medical disease [3]. The condition affects 2% of the world's population, with a frequency of around 4.6 percent in affluent countries[4]. It is characterized by scaly, red, coin-sized skin lesions that are strongly delineated on the elbows, knees, and ankles, Hands and feet, as well as the scalp. The following are examples of symptoms. Itching, irritation, stinging, and discomfort are all symptoms of an allergic reaction. Rarely, it's possible that the entire body's skin surface is infected. The koebner phenomenon [5] and Auspitz's sign [6] are diagnostic signs for psoriasis. The cause of this persistent illness is unknown. The most frequent etiological cause is stress, and individuals with chronic illnesses such as Crohn's disease are more prone to get psoriasis [7]. Beta-blockers, lithium, synthetic antimalarials, nonsteroidal anti-inflammatory medications (NSAIDs), and tetracycline's appear to have a substantial causal connection with psoriasis.

The risk of cardiac co-morbidities is higher in patients with a severe form of this illness [8]. There are several kinds of psoriasis, depending on how it affects the sufferer. The most common types of psoriasis are psoriasis vulgaris and plaque-type psoriasis (almost 90 percent). The pruritic plaques coated in silvery scales distinguish plaque-type psoriasis [9]. Tazarotene (TZR) is an aliphatic retinoid compound applied as a topical gel is effective in skin problem. It is a prodrug that is hydrolyzed into Tazarotenic Acid within the skin associate degreed has an antiproliferative and anti-inflammatory impact by attaching to the intracellular retinoic acid receptor particle and ever-changing cistron activity. Tazarotene has high lipophilicity therefore its solubility may be increased with incorporation of lipidic vehicle within the kind of SLN. Tazarotenic acid binds to any or all 3 members of the retinoic acid receptor (RAR) family: RAR α, RAR β, and RAR γ, however with relative property for RAR β, and RAR γ, and should alter organic phenomenon. Its main impacts area unit cell differentiation regulation and pro-inflammatory intermediary down regulation (IL-6, migration inhibition factor-related protein) [10]. Tazarotene is additionally utilized locally within the treatment of skin problem, taking advantage of its antiproliferative characteristics by inhibiting amino acid enzyme and keratins [11]. Tazarotene may be conjointly utilized in the treatment of fine wrinkles, pigmentation of skin, acne, plaque skin problem and sun broken skin. Irritation, burning, and peeling of the skin area unit all frequent. This may be decreased by careful application to the plaques solely [12]. Tazarotene have short native bioavailability i.e. 14%, thus our study aimed to formulate stable tazarotene loaded solid lipid nanoparticles based mostly gel with improved bioavailability [13].Psoriasis is a chronically recurrent, inflammatory, autoimmune skin disease that affects 2–5% of the world's population. The primary goal of this study was to create and improve a tazarotene solid lipid nanoparticles (SLN) formulation for efficient medication delivery.

MATERIALS AND METHODS

MATERIALS

Tazarotene was kindly gifted by Glenmark Pharmaceuticals (Mumbai, India). Glyceryl monostearate, Triasterin, Tween 80, Span 20, Glycerol, Propylene glycol, Methanol were procured from Research Lab Fine Chemicals (Mumbai, India). Beeswax and Triethanolamine were obtained from Loba Chemie (Mumbai, India). Poloxamer 188,

Poloxamer 407 and Carbopol 934 P were obtained from Analab Fine Chemicals (Mumbai, India). All other chemicals and solvents were of analytical grade.

METHODS

Preliminary Studies

Solubility Studies

Solubility study of Tazarotene in different lipids and surfactant

Solubility studies are carried out to determine the active material's solubility in the excipients. This approach aids in the comparison of drug solubility in various solvents and the selection of formulation excipients with good solubility.

Solubility study of Tazarotene in different lipids

The drug's solubility in lipids is responsible for the drug's high entrapment in the lipid matrix. As a result, the drug's solubility in different lipids was evaluated in order to identify the lipid with the greatest potential to solubilize the drug. Procedure: 100 mg of the lipid was precisely weighed and put to the glass vial. The drug was progressively introduced to the vial in increasing amounts. The temperature of this combination was raised over the melting point of the lipid by 5-10 ° C. The presence of a clear drug solution in the melted lipid indicates that the medication has been dissolved in the lipid melt. This might be referred to as a conclusion. The amount of drug that was added was calculated.

Solubility study of Tazarotene in different surfactants

Procedure: Excess Tazarotene was added to a vial holding 2 ml of the surfactant to conduct solubility tests. They've been correctly combined. The mixture was agitated for 3 hours on an orbital shaker. They were then placed in cooling centrifuge vials for 30 minutes at 15000 rpm. The supernatant was removed and diluted with methanol to allow for UV quantitation. Tazarotene concentration was calculated. Surfactant containing high amount of tazarotene was selected [14, 15].

Standard Calibration Curve of Tazarotene

Preparation of Stock solutions of Tazarotene: Stock solutions of Tazarotene was ready in wood alcohol. 100 mg of Tazarotene weighed accurately and transferred into 100 ml volumetric flask. The amount was created up to 100 ml with methanol (1000 µg/ml). It had been then sonicated for 5 minutes. 10 ml of sample was withdrawn from the sonicated solution and it had been diluted upto 100 ml with methanol to make 100 µg/ml concentration of stock solution.

Preparation of standard calibration curve for Tazarotene in Methanol

0.2,0.4,0.6,0.8,1.0,1.2,1.4,1.6,1.8,2.0 ml of stock solution (100 µg/ml) was pipette out into 10 ml volumetric flask and volume was made up to 10 ml with methanol. The absorbance of the solutions were measured by UV-visible double beam spectrophotometer at 351 nm against methanol used as blank. Absorbance of series of solution was taken and a graph of absorbance vs, concentration was plotted[16].

FT-IR Spectrum (Drug – Excipients Compatibility Studies)

Tazarotene and excipients were subjected to FT-IR analysis. The first step was to calibrate the FT-IR using KBr. Tazarotene was combined with KBr and crushed into pellets with a hydraulic press. To obtain a result, this pellet was put on the IR cuvette. To achieve results, the other components were simply combined with KBr and put in an IR-cuvette. FT-IR studies are done to check the compatibility of the active material with other excipients used. The compatibility study was carried out to check any kind of interactions among drugs with lipids like GMS and Poloxamer 188 at a wavelength of 500 to 4000 cm−1[17].

Melting Point

A melting point apparatus is a scientific equipment that is used to determine a chemical substance's melting point. The melting point of a chemical compound can be used to determine its purity. The inclusion of even trace quantities of impurities in a chemical compound causes the melting point range to shift. Tazarotene's melting point was measured using a capillary technique and a melting point equipment. This study was performed in triplicate manner [18].

Partition Coefficient

The shake flask technique was used to determine the partition coefficient.

Preparation

N-Octanol: The partition coefficient was calculated using reagent of high purity and analytical grade. Water: Distilled water was used.

Procedure

10 mg of the Tazarotene was mixed with 25 ml of distilled water and 25 ml of n-Octanol. Separately, it was shook for half an hour. After that, both phases were combined in a separating funnel and shook for 4 hours (on orbital shaker and allowed those to stand to get phase separated). Solution of 0.1 N NaOH and 0.1 N HCI was prepared. After separation, organic and inorganic phase was collected separately. 5 ml of each phases was taken and back titration using excess NaOH was performed [19, 20].

Experimental Design

DOE model (Box Behnken) for TZR loaded SLN

Design-Expert software is used to create a design matrix in order to discover the optimized formulation batch. Box Behnken design was used in TZR SLN preparation. The operation of optimization by full factorial design is necessary in order to complete the investigation and generate mathematical models. The results of each experiment were recorded, and multiple linear regression analysis and F-statistics were used. The significant terms were recognized using an appropriate model. The concentration of lipid, sonication time and concentration of stabilizer is the independent variables and the entrapment efficiency, percentage of drug release, particle size is considered as dependable parameters while utilizing DOE [21, 22, 23] .

Formulation of Solid Lipid Nanoparticles of Tazarotene

The SLNs of TZR were developed by using hot homogenization and later with the Probe sonication method. In the hot homogenization method, lipid, surfactant and stabilizer were melted above their melting point. TZR was incorporated in the melted lipid phase and allow dissolving it. The aqueous phase was also heated about the same temperature of lipids and added slowly in the lipid phase, and homogenized them at 2500 rpm at about 70°C utilizing a mechanical stirrer about 30 min. The prepared coarse oil in water emulsion was further sonicated by probe Sonicator for definite time. SLNs of TZR were developed as Nano emulsion which was cool and stored [24, 25].

Table no. 1 shows independent variables and their corresponding levels of TZR loaded SLN preparation for Box Behnken design.

Table no. 2 shows Box Behnken design for formulation of TZR loaded SLN

Characterization of Tazarotene loaded SLN

Particle size analysis

A digital microscope was used to determine particle size. PixelPro was the software utilized. The average particle size was measured in nanometers. The software (Pixel Pro) for image analysis of nanoparticles was used to mount

SLNs on slides and position them over the stage of a micrometer. Each test was performed on a minimum of 100 particles, with the mean value given [26].

Drug Entrapment Efficiency

The centrifugation technique was used to assess the entrapment effectiveness of SLN dispersion. To collect the supernatant liquid, the SLN dispersion was centrifuged at 9000 rpm for 60 minutes in a cooling centrifuge. After dilution with distilled water, the recovered 1 ml liquid was filtered to determine the free drug concentration. The absorbance was measured at 351 nm in a UV Spectrophotometer to calculate the entrapment efficiency using following formula: [27, 28].

Entrapment efficiency (%) = wt. of drug incorporated / wt. of drug initially taken x 100

In-vitro drug release studies

A synthetic cellophane membrane with a molecular weight of 12000 was used to test drug release. The vertical Franz diffusion cell was utilized as the apparatus. A pH 6.8 phosphate buffer was made. The diffusion cell was filled to the mark with the prepared buffer. The receptor compartment is the name given to this compartment. The temperature of the receptor compartment was kept at 37°C and the magnetic stirrer was used to agitate it constantly. A 10 mg SLN dispersion was put on the cellophane membrane facing the donar chamber. 1 mL of the receptor compartment sample was taken and diluted in methanol to a volume of 10 mL. To calculate concentration, UV analysis was used. Similarly, after every one hour the sample was withdrawn and was subjected to UV analysis to calculate concentration. The UV analysis was carried out three times. The study was carried out for 8 hours [29, 30].

Zeta Potential

The zeta potential investigations were done with the zeta sizer. In a test tube, 1 mL of the dispersion was collected and diluted with distilled water. For another 10 minutes, ultrasonication was used to avoid agglomeration. The solution was correctly poured into the glass cuvette. It was determined what the zeta potential was. The stability behavior of the formulation according to the zeta potential values is given in the table [31].

Table no. 3 shows zeta potential vs. stability behavior

pH measurement

pH measurement was carried out with the aid of a pH metre.1 ml of SLN was dissolved in 100 ml of purified water. Allowed 2 hours to pass. pH was checked using standard buffers by dipping the rods in the buffers. After that, rod was dipped in SLN solution. This procedure was carried out in triplicate manner [32].

Lyophilization of SLNs

SLNs are lyophilized. The Lyophilization process was used to improve the stability of SLNs. The drug-loaded SLNs containing tazarotene were produced and stored in the deep freezer overnight at 40°C. To get powdered lyophilized product, the frozen samples were vacuum freeze-dried for around 48 hours [33].

Preparation of Tazarotene Loaded SLN Gel

The tazarotene-loaded SLN gel was made by dissolving the appropriate amount of Carbopol 934 P (1 percent w/w) in a tiny amount of distilled water and allowing it to hydrate for 4–5 hours. Later, glycerol (30% w/w) and propylene glycol (10% w/w) were added to the aqueous dispersion. The addition of 0.5 ml of triethanolamine prevented the inclusion of air, and the drug's lyophilized tazarotene nanoparticles powder were mixed into the gel with gentle stirring. Finally, the remaining water (58.85% w/w) was added to bring the volume of dispersion up to 100% w/w. [34].

Evaluation of Tazarotene Loaded SLN Gel

Homogeneity

This was checked visually. Homogeneity test is done to check whether the formulation is in single phase and the phase separation takes place [35].

Colour

This was also checked visually [35].

Appearance

This was checked visually [35].

pH

This was checked using pH meter. 1 g of gel is dissolved in 100 mL of distilled water. Allowed 2 hours to pass. pH was checked using standard buffers by dipping the rods in the buffers. After that, rod was dipped in gel solution. Procedure was carried out in triplicate manner [35].

Viscosity

Viscosity of the formulations was determined by Brookfield viscometer. The viscosity of samples was measured at 37°C. The viscosity of formulation was determined without dilution by using Brookfield viscometer (Brookfield viscometer LVDV) with the help of spindle No.3. At different set of RPM such as 10, 20 and 100. After stabilization viscosity of formulations was recorded [36].

Spreadability

The gel's spreadability was determined by spreading 0.5 g of the gel on a glass plate and then using a second glass plate. Constant weight(in grams) was added on the pan of moving glass slide for fixed time(in sec), the distance travelled by the slide is measured (in cm) and placed in a given formula to find out the Spreadability of the formulation [36].

$$\text{Spreadability} = \frac{\text{Distance travelled by slide} \times \text{weight taken}}{\text{time}}$$

In-Vitro Drug Release:

A synthetic cellophane membrane with a molecular weight of 12000 was used to test drug release. The vertical Franz diffusion cell was utilized as the apparatus. A pH 6.8 phosphate buffer was made. The diffusion cell was filled to the mark with the prepared buffer. The receptor compartment is the name given to this compartment. The temperature of the receptor compartment was kept at 37°C and the magnetic stirrer was used to agitate it constantly. A 10 mg SLN loaded gel was put on the cellophane membrane facing the donar chamber. 1 mL of the receptor compartment sample was taken and diluted in methanol to a volume of 10 mL. To calculate concentration, UV analysis was used. Similarly, after every one hour the sample was withdrawn and was subjected to UV analysis to calculate concentration. The UV analysis was carried out three times. The study was carried out for 8 hours [36].

Stability Study

Stability Studies were carried out after storing the promising formulation at two different temperatures 50C± 30C and 250C± 30C temperature with 65%±5% RH for 6 months. The formulations were tested for physical parameters, viscosity, and spreadability and appearance to check stability [37].

RESULTS AND DISCUSSION

Solubility study of Tazarotene in different lipids

Solubility of tazarotene was studied in different lipids like glyceryl monostearate, beeswax, Triasterin. The solubility of Tazarotene was higher in Glyceryl monostearate. So, on the basis of solubility Glyceryl monostearate was selected for the further formulation.

Solubility study of Tazarotene in different surfactants

The different types of surfactants Tween 80, Span 20, Tween 20, Poloxamer 188, and Poloxamer 407 were used to determine the maximum solubility of drug in surfactant. Tween 80 was chosen as the surfactant based on the drug's solubility in the surfactant. Also based on solubility study of surfactants, Poloxamer 188 tops at second position in terms of maximum solubility after Tween 80. So we have used Poloxamer 188 as a stabilizer in preparation of solid lipid nanoparticles of tazarotene. It also used as one of the independent variable. In this study we are also going to study the effect of stabilizer concentration on particle size, drug entrapment and drug release [38].

FT-IR Spectrum (Drug – Excipients Compatibility Studies)

Drug-Excipient Compatibility studies were performed using FTIR Spectrophotometer. IR spectra of pure Tazarotene with physical mixture of excipients (Tazarotene + GMS + Poloxamer 188) was recorded and studied. All the characteristics peaks of Tazarotene were present in all spectra at respective wavelength when compared with standard frequencies of functional groups. This confirms that the Tazarotene is present in pure and unchanged form in the physical mixture of excipients. ATR captured the spectra of Tazarotene, which revealed a strong peak at 3672.47 due to hydroxyl stretching, 2198.85 for C ≡ C stretching, and 1716.65 for C = O, 1153.43 for C-O, 1473.62 for CH2. The physical combination of Tazarotene, GMS, and Poloxamer 188 verified the availability of all peaks and the absence of any functional peaks. As a result, it was concluded that the formulation ingredients were compatible and that there was no substantial physicochemical interaction between the drug, lipid, and stabilizer.

Melting Point

Melting point of Tazarotene was found to be 104.06±0.61°C.

Partition Coefficient

Partition coefficient of Tazarotene was determined by shake flask method. It was found to be 4.3. If the value of partition coefficient is greater than 1 then the substance is said to be more soluble in fat like substance or we can say it is lipophilic/Hydrophobic. If the value of partition coefficient is less than 1 then the substance is said to be more soluble in water or we can say it is Hydrophilic.Values for partition coefficient typically range between -3 (very hydrophilic) and +10 (extremely lipophilic/hydrophobic). If the solubility of drug is greater, then its partition coefficient value is greater and thus greater is the permeability of a membrane for a drug. From all these and partition coefficient value 4.3 of tazarotene we can conclude that tazarotene is lipophilic in nature and its solubility can be enhanced by preparing solid lipid nanoparticles of tazarotene [39].

Formulation of Tazarotene Loaded Solid Lipid Nanoparticles

SLNs were made using a hot homogenization approach followed by sonication using a probe sonicator. It takes two immiscible stages to make SLNs. An emulsifier is added to the oil and aqueous phases to aid in the development of an emulsion by lowering interfacial tension. According to the Box-Behnken design, each of the 17 batches was formulated independently.

Optimization of Tazarotene Loaded SLNsby Using Box-Behnken Design

The influence of surfactant concentration, stabilizer concentration, and sonication time on several parameters such entrapment efficiency, particle size, and drug release was studied using the Box-Behnken design.

Characterization of Tazarotene loaded solid lipid nanoparticle

Evaluation of batches for optimization: The SLN batches were further analyzed and they were named as F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12, F13, F14, F15, F16, and F17.

Physical Appearance

The prepared formulations were found to be homogenous, white and consistent.

Entrapment Efficiency

Final equation in terms of Coded Factors

Entrapment efficiency= + 59.94- 0.8150A +5.78B +1.08 C -2.66 AB -4.20 AC -3.00 BC +11.74 A^2 +2.33 B^2 +3.94 C^2

The Model F-value of 227.51 implies the model is significant. P-values less than 0.0500 indicate model terms are significant. The effect of independent variables on entrapment efficiency is illustrated in figure no. 2.

Effect of concentration of lipid and concentration of stabilizer on entrapment efficiency

Entrapment efficiency is influenced by lipid content. The higher the concentration of lipids, the greater the entrapment of active material in lipids. Low lipid concentrations can result in less active material being entrapped in the lipid. Because lipids function as solubilizing agents for highly lipophilic drugs, the % EE increased as the amount of lipid increased.The entrapment efficiency increased as the concentration of the stabilizer increased. This might be because raising the stabilizer concentration increases the drug's stability [40].

Effect of sonication time on Entrapment efficiency

The efficiency of entrapment is related to the sonication time. The longer the sonication period, the faster the nanoparticles divide. Also greater the sonication time, greater will be the entrapment. This may reduce the likelihood of particle agglomeration. As a result, the particle size decreases as the sonication period rises. But after a maximum time period as sonication time further increases then it can cause decrease in entrapment efficiency. Therefore optimization of sonication time is required to develop formulation with maximum entrapment efficiency [40].

Drug Release

Final equation in terms of Coded Factors

Drug Release = +71.35 +0.3450 A -1.70 B +4.99 C +4.63 AB -2.23 AC +7.01 BC +5.27 A2 +2.65 B2 +8.07 C2. The Model F-value of 335.61 implies the model is significant. P-values less than 0.0500 indicate model terms are significant. The effect of independent variables on drug release is illustrated in figure no. 3.

Effect of concentration of lipid and concentration of stabilizer on Drug release

The drug release rate reduces as the lipid concentration rises; this might be owing to the increased drug concentration in the vesicle's inner core. Due to a difference in the active material's partition coefficient and the lipophilicity of the lipid, drug release may be reduced. The drug's diffusion from the GMS to the aqueous medium of dissipation was slowed by its lipophilicity. As the stabilizers concentration decreases, drug release increases [41].

Effect of sonication time on Drug release

Increase in sonication time causes increases in drug release [41].

Particle Size

Final equation in terms of Coded Factors

Particle Size = +31.47 -0.1087 A -0.5112 B -0.3775 C -0.0500 AB +0.7875 AC +0.4675 BC +0.5575 A2 -0.0925 B2 +0.0750 C2. The Model F-value of 60.31 implies the model is significant. P-values less than 0.0500 indicate model terms are significant. The effect of independent variables on Particle size is illustrated in figure no. 4.

Effect of concentration of lipid and concentration of stabilizer on Particle size

Increased lipid concentrations cause the solution to become more viscous, reducing the stirrer's shear capacity and having an inverse effect on particle size. Therefore as lipid concentration increases, particle size decreases. As the concentration of stabilizer increase, particle size decreases [42].

Effect of sonication time on Particle size

The particle size decreased when the sonication time was increased. But after a maximum time, as sonication time increases it causes increase in particle size due to agglomeration. Therefore, optimization of sonication time is required for obtaining formulation with smaller particle size [42].

Zeta Potential

The value of the zeta potential of Tazarotene loaded SLN formulation was found to be -50 mV. The higher stability indicated by the high negative surface charge on SLN particles, it happens because of repulsion between similarly charged particles in the system, hence it was observed from the table of zeta potential v/s stability behavior, that the particles in this formulation having good stability as its stability is between range of ±40 to ±60.

Figure no. 5 shows zeta potential of the optimized batch (F7).

pH

The pH of optimized formulation of Tazarotene SLN was found to be 5.2 and the pH of human skin is in the range of 4 to 7, so it was concluded that the prepared formulation was compatible with human skin [43].

Evaluation of Tazarotene loaded SLN based Gel:

Homogeneity: The developed gel was tested for homogeneity by visual inspection and it was found to be homogenous.

Physical Evaluation

Physical parameters like colour, appearance, and odour were evaluated by physical inspection and it was found to be transparent, smooth and odour was found to be characteristic.

pH Measurement

The pH of optimized formulation of Tazarotene loaded SLN based gel was found to be 5.8 and the pH of human skin is in the range of 4 to 7, so it was concluded that the prepared formulation was compatible with human skin.

Viscosity and Rheological studies

Viscosity of the formulations was determined by Brookfield viscometer. The viscosity of optimized formulation of Tazarotene loaded SLN based gel was found to be 2618±52.12 cps.

Spreadability

Spreadability plays important role in patient compliance and helps in uniform application of the gel to the skin. A gel spreads easily and takes less time to spread on the skin. Spreadability of the gel was found to be of 6.18±0.05 gm.cm/sec in 60 sec.

***In vitro* Drug Release**

The drug release of gel after 8 hours was found to be 87.46±0.14%.

Figure no.6 showsin vitro drug release of optimized gel preparation

Stability Studies

Studies were carried out after storing the promising formulation at two different temperatures 50C± 30C and 250C± 30C temperature with 65%±5% RH for 6 months. Table 5 and 6 shows data for appearance, viscosity, spreadability

and pH. The formulation F7 shows no change in appearance, viscosity, spreadability and pH after 3 months at 5°C± 30° C.

CONCLUSION

In the present work, Tazarotene loaded SLNs were successfully prepared by hot homogenization followed by sonication technique. The various physicochemical properties, particle size, drug release entrapment efficiency were affected and can be controlled by using optimization technique. Alteration in concentration of lipid, concentration of stabilizer and sonication time can overcome the problems associated: Box Behnken design was used for the experiment and & formulations were developed. The Box- Behenkn design showed optimized result at 7.5 minute sonication time, 500 mg stabilizer concentration and 1 mg lipid concentration. F7 formulation was found to be optimized. Its particle size was smaller as desired, entrapment efficiency and drug release was found to be maximum, so the desired aim and objective could be achieved by Tazarotene loaded SLN based gel. Tazarotene-loaded SLN-based gels reduced the adverse effects of traditional dosage forms while still delivering the medication at a regulated pace. The hot homogenization technique was therefore useful in achieving high entrapment efficiency with the water-insoluble substance Tazarotene. As a result, it was determined that solid lipid nanoparticles were employed as drug carriers for lipophilic medicines to improve the drug release of water-insoluble pharmaceuticals, and that they could be beneficial in the treatment of psoriasis.

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CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

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Table 1: Independent variables and their corresponding levels of TZR loaded SLN preparation for Box Behnken design.

Variables	Levels	
	-1	+1
Concentration of lipid (mg)	1	4
Concentration of poloxamer 188 (mg)	100	500
Sonication time (Minute)	5	10

Table 2: Box Behnken Design for Formulation of TZR loaded SLN

Batch no.	Factor 1 (mg) (Lipid Concentration X_1)	Factor 2 (mg) (Poloxamer 188 Concentration X_2)	Factor 3 (min) (Sonication time X_3)
F 1	2.5	100	5
F 2	4	300	10
F 3	2.5	300	7.5
F 4	4	100	7.5
F 5	2.5	100	10
F 6	2.5	500	5
F 7	1	500	7.5

F 8	1	300	5
F 9	1	100	7.5

Table 3: Zeta potential vs. stability behavior

Sr.no.	Zeta potential	Stability behavior
1	0 to ±5	Rapid Coagulation/Flocculation
2	±10 to ±30	Incipient instability
3	±30 to ±40	Moderate Stability
4	±40 to ±60	Good Stability
5	More than ±61	Excellent Stability

Table 4: Box Behnken Design for Optimization of Tazarotene Loaded SLN

Batch no.	Factor 1 X_1	Factor 2 X_2	Factor 3 X_3	Response1 Y_1	Response2 Y_2	Response3 Y_3
	Lipid Concentration (mg)	Poloxamer Concentration (mg)	Sonication Time (Min)	Entrapment efficiency %	Drug release %	Particle size (nm)
F1	2.5	100	5	55.45±0.18	85.65±0.13	32.87±0.18
F2	4	300	10	70.95±0.24	88.36±0.21	32.33±0.13
F3	2.5	300	7.5	59.94±0.31	71.35±0.28	31.47±0.20
F4	4	100	7.5	70.45±0.16	76.4±0.11	32.32±0.24
F5	2.5	100	10	64.87±0.1	81.45±1.34	31.26±0.09
F6	2.5	500	5	73.56±0.23	68.65±0.48	31.65±1.73
F7	1	500	7.5	82.89±0.11	72.87±0.6	30.71±0.98
F8	1	300	5	71.89±0.30	76.55±0.97	33.45±0.72
F9	1	100	7.5	66.55±0.89	85.94±0.29	32.37±1.44
F10	2.5	300	7.5	59.94±0.26	71.35±2.01	31.47±1.03
F11	2.5	500	10	70.98±0.35	92.5±1.20	30.97±0.08
F12	2.5	300	7.5	59.94±1.09	71.35±1.52	31.47±0.66
F13	2.5	300	7.5	59.94±1.15	71.35±0.27	31.47±0.80
F14	4	500	7.5	76.15±0.15	81.85±0.68	31.4±0.82
F15	2.5	300	7.5	59.94±1.48	71.35±0.42	31.47±0.30
F16	1	300	10	81.19±0.14	91.16±1.31	31.04±1.38
F17	4	300	5	78.45±1.44	82.67±1.67	31.59±1.20

(Where n=3, ± SD)

Table 5 : Selected F7 formulation for stability study at 5°C ± 30°C

Time Period	Appearance (Colour)	Viscosity (cps)	Spreadability (gm.cm/sec)	pH
Initial	Transparent	2615±0.07	6.16±0.10	5.5±0.05
After 3 months	Transparent	2600±0.34	5.98±0.07	5.1±0.07

(where n=3, ±SD)

Table 6: Selected F7 formulation for stability study at 25 C± 30° C

Time Period	Appearance (Colour)	Viscosity (cps)	Spreadability (gm.cm/sec)	pH
Initial	Transparent	2579±0.56	5.65±0.32	5.5±0.05
After 3 months	Transparent	2599±0.19	5.59±0.72	5.4±0.07

(where n=3, ±SD)

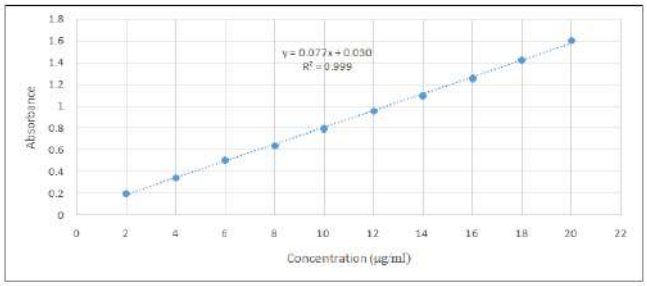

Figure 1: Calibration curve of Tazarotene in Methanol

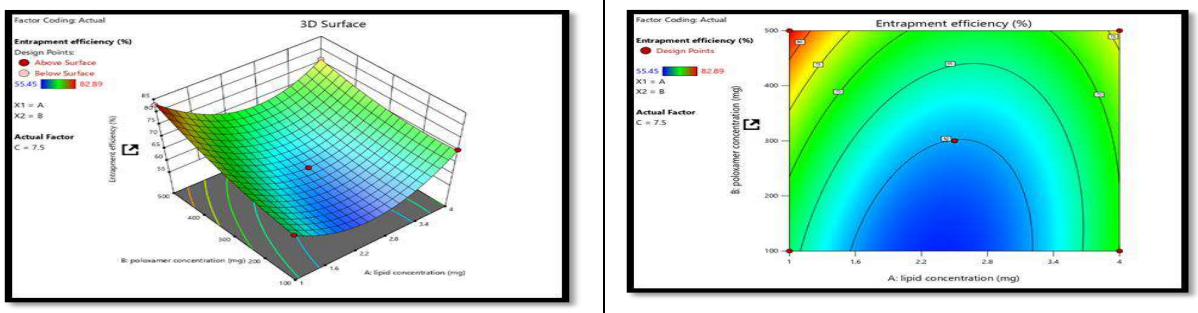

Figure 2: 3D Response surface plot and contour plot for the effect of independent variables on entrapment efficiency

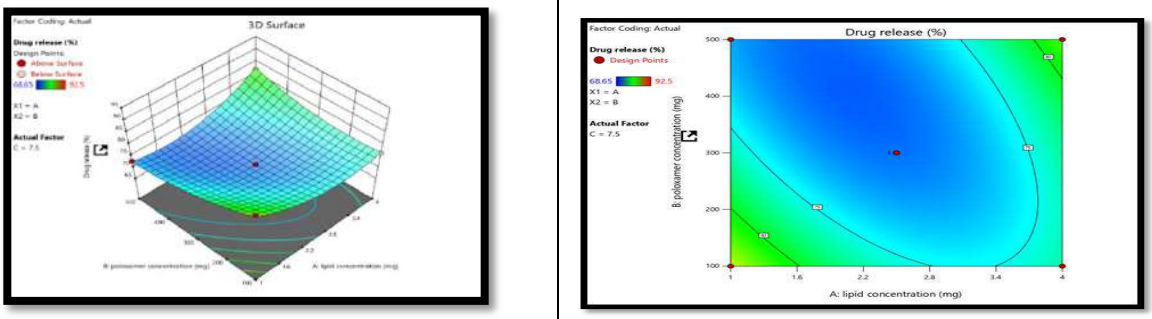

Figure 3:3D Response surface plot and contour plot for the effect of independent variables on Drug Release

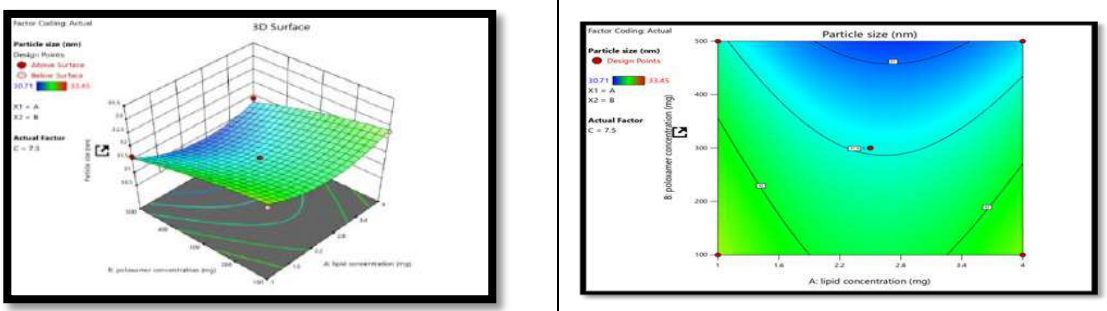

Figure 4: 3D Response surface plot and contour plot for the effect of independent variables on Particle Size

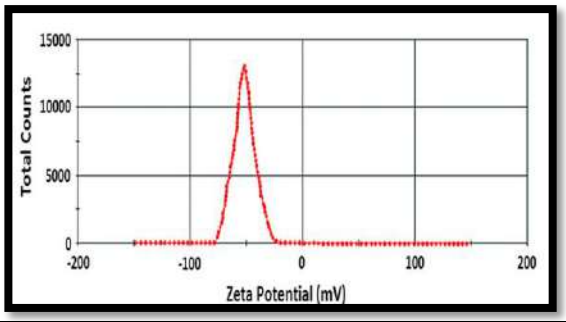

Figure 5: Zeta Potential of the Optimized Batch (F7)

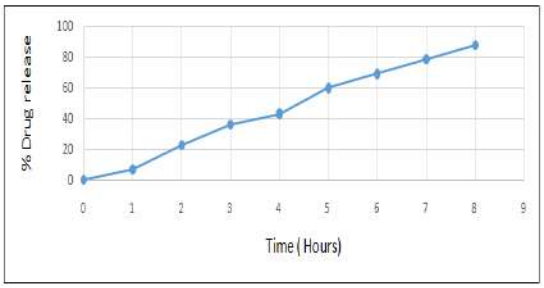

Figure 6: *In vitro* Drug Release of Optimized Gel Preparation

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RESEARCH ARTICLE

A Model on Economic Production Quantity of Imperfect Quality Deteriorated items with Controllable Carbon Emissions

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ABSTRACT

Every manufacturing process is incorporated with carbon emission which results pollution. In order to regulate this Government has imposed certain regulations for which, now-a-days, environmental tax is a major concern in production industry. Further, so far as production is concerned, imperfect products are unavoidable which leads loss of profit to every manufacturer. Keeping this in mind, in the present article, a model has been formed on economic production quantity (EPQ) of imperfect quality of items that are deteriorated with controllable emission not allowing any shortages. In this model defective items are not treated as completely useless. The aim of this article is to minimize the total operation cost including emission cost. The model is illustrated with an example by taking numerical values and validated its effectiveness through sensitive analysis.

Keywords: Inventory, production, controllable carbon emission rate, imperfect quality, carbon tax.

INTRODUCTION

Incorporation of quality and environmental issues in manufacturing and stock fashions has acquired full-size interest within side the stock management. The developing strain of worldwide warming and weather extrude has pressured industries and governments to mitigate their carbon emissions. Most of the nations like USA, UK, India etc. centered to lessen carbon emission. The corporations like United Nations (UN) and the European Union (EU) have additionally designed mechanisms or promulgated rules to govern carbon emissions. Hence, now-a-days, maximum

of the carbon emissions discount strategies have centered particularly on adopting greater green strength system or facilities, locating much less polluting reasserts of strength and imposing strength saving programs. Because of climate change, many nations are under growing pressure to prevent this phenomenon to gradual down carbon emissions with some objectives to lessen emissions or law preparation initiatives to store energy and having fewer emissions. As low carbon laws and regulations become increasingly strict, it is necessary for production houses to try their best to reduce carbon emissions. The production houses are s able to earn revenue by the way of carbon trading by controlling carbon emission within the permissible limits. During production process, CO_2 is emitted and mixing with air causes increase of temperature which leads to global warming. For this cause of emission of CO_2, manufacturer pays compulsory tax for production of items. Sometimes it happens that he is urged to pay penalty cost too because of limitless carbon emission. Hence the production manufacturer has to control the emission to increases the profit. Therefore In this paper, we develop an economic production inventory model of constant deteriorating products with reduction of carbon emission in which shortages are not allowed.

In manufacturing production engineering, production of faulty items together with non-faulty could be inevitable. It may be due to malfunction of the machine and imperfect manufacturing process. Therefore, while modeling an inventory system, the defective items obtained in the production process cannot be avoided. Regulating this, so many literatures have been found with necessary modification of classical EOQ and EPQ models. Dealing with imperfect items, the first work was found in 1986. Porteus (1986) and Rosenblatt and Lee (1986) incorporated the concept of imperfect items in their work. Therefore, they were called the pioneers of this field. In their study, they considered the circumstances in which, beginning with the production with perfect products under consideration shifted to out-of-control state of some random approach of time dealt with defective products too. Subsequently, a model on lot sizing and inspection of imperfect products was developed by Zhang and Gerchak (1990). Salamah and Jaber (2000) consider an EPQ/EOQ model for imperfect quality when using the EPQ/EOQ formula. During last two decades, several models regarding imperfect quality of items with non-shortages had been developed by many researchers like Goyal and Cardenas-Barron (2002), Papachristos and Konstantaras, Maddaha and Jaber (2008) etc . However, researchers like Sarkar and Moon(2011), Wee et al. (2013) had studied and developed models on imperfect items allowing shortages. In 2014, Mukhopadhyay and Goswami (2014) presented an EPQ model with three types of defective items under two different scenarios. Considering partial backordering and giving discount to defective items, Cunha et al. (2018) studied an EPQ model. Manufacturing units cannot avoid carbon emission which is a key factor for global warming. To regulate this government have imposed high carbon emission tax. This influences the inventory control. To overcome this, Sinha and Modak (2019) developed an EPQ model reckoning carbon emission. Using green supply chain, Panja and Mondal (2019) proposed a model considering selling price dependent demand rate and some parameters as fuzzy nature. Recently, in this line and also using fuzzy management many works have been done. These works can be found in Daryanto et al. (2019), De et al. (2020), Mishra et al. (2020). Mishra et al.

(2020) proposed a sustainable economic production quantity model with reduction of carbon emission by implementing green technology under shortages. Rout et al. (2020) developed a sustainable supply chain inventory management model for a single manufacturer and a single buyer's incorporation with both imperfect production and deterioration. They implement different regulatory policies of emission reduction which mitigate the effect of carbon emission by reducing its volume. Very recently, Ruidas et al. (2021) proposed a model discussing defective item production inventory model with carbon emission regulation policy and considering different carbon emission parameters as interval numbers. Quite recently, incorporating green house facility, Mashud et al. (2021) provided a model of non-instantaneous deteriorating items with controllable carbon emission. However, Sepehri et al. (2021) developed for defective constant deteriorating items controlled by incorporating preservation technology and carbon reduction technology. Singh and Mishra (2021) developed a same type of model for non-instantaneous deteriorating items and carbon emission under triangular type of demand pattern. Deterioration of goods always causes loss. Hence deteriorating rates directly affected on the profit function. The research on deteriorating items has begun from 1963. A model with exponentially decaying inventory was initially proposed by Ghare (1963). In recent years, many researchers have done a lot of work on inventory problems about deteriorating products. Deterioration is defined as decay, damage, spoilage etc. such that the items are not in a condition for being used for their original purpose.

Electronic goods, radioactive substances, food-grains, foods, alcohols, gasoline are the examples of deteriorating products. There are many researchers who contribute their works on deteriorating items such as Kang and Kim(1983), Dave and Patel(1981), Wee (1997), Bhunia et al.(2009), Chang et al. (2010), Raula et al. (2018), Indrajitsingha (2018, 2019, 2020), Sahoo et al.(2019, 2021), Cenk (2021). In this paper also, deterioration is taken as a model parameter and considered to be constant through the model cycle. In the present model, the length of the cycle is taken as time period T. The whole period is divided into two parts such as $0\ to\ T_1$and $T_1\ to\ T$. In the first period, the model is started with zero inventory and the manufacturer starts producing items both perfect and defective. It is assumed that inspite of defective product and the constant demand which has to be met, the inventory level will get peak position at time T_1. Then production is ceased. Because of demand and deterioration the inventory level will be zero at the end of the cycle. Considering the carbon emission during the production time, the aim of this article is to find $T_1$for which both total expected cost and expected total carbon emission is minimized.

MODEL NOTATION AND ASSUMPTIONS

Notations

The paper is incorporated with the following notations and assumptions:

p	:	Rate of production (units/unit time)
d	:	Demand rate (units/unit time)
x	:	Probability of defective products per cycle
$E[x]$	:	Expected value of x
S_c	:	Set-up cost per cycle (\$/cycle)
P_c	:	Unit production cost (\$/unit)
q_c	:	Fixed inspection cost for quality check (\$/cycle)
x_c	:	Inspection cost per unit (\$/unit)
h_{c1}	:	Holding cost of the good product per unit in a unit time (\$/unit)
h_{c2}	:	Holding cost of the defective products per unit in a unit time (\$/unit)
d_c	:	Unit deterioration cost (\$/unit)
w_c	:	Waste disposal cost per ton (\$/unit)
b	:	Unit average weight of solid waste produced (ton/unit)
θ	:	Deterioration rate ($0 \leq \theta < 1$)
P_{ec}	:	Unit cost for emission in production (\$/unit)
I_{ec}	:	Unit inventory emission cost (\$/unit)
A_{ep}	:	Average electricity consumption for production (kWh/unit)
A_{ew}	:	Average electricity consumption for warehouse space unit (kWh/m^3)
S_{eg}	:	Standard emission for electricity generation (ton CO_2/kWh)
s	:	Unit product space occupancy (m^3/unit)
C_t	:	Tax rate for CO_2 emission (\$/ton CO_2)
T	:	Length of cycle
T_1	:	Production consumption period (year)
T_2	:	Consumption period (year)
q_0	:	Total production quantity per cycle (unit)
q	:	Total production of good product per cycle (unit)
$I_g(t)$	:	Inventory level of good products at any time t (unit)
I_p	:	Inventory at maximum level (unit)
I_d	:	The defective products inventory level at any time t (unit)
TEC	:	Total expected cost (\$/unit)
$ETCE$	:	Expected total carbon emission

Assumptions

i. One type product is produced with constant demand.
ii. There is no replacement of items that are deteriorated.
iii. Rate of deterioration is considered to be constant.
iv. Production rate is assumed to be constant and is considered to be higher than that of rate of demand.
v. There is a 100% quality checking of the product at the workshop. The defective products are stored until time T_1 and will be sold at a secondary market with subsidized price. Unit holding cost of the good product (h_{c1}) is higher than that of the defective products (h_{c2}).
vi. Carbon emission occurs during production and inventory holding time.
vii. During production in a plant, the carbon dioxide released from machine. Cost of production emissions (P_{ec}) is a function of average electricity consumption per unit product (A_{ep}), electricity generation standard emission (S_{eg}) and carbon tax rate (C_t). $P_{ec} = A_{ep}.S_{eg}.C_t$
viii. During storage of goods in warehouses, inventory emission is generated by electricity consumption. The average inventory emission cost per unit product (I_{ec}) is a function of space occupied by a unit product (s), average electricity consumption per warehouse space unit (A_{ew}), electricity generation standard emission (S_{eg}) and carbon tax rate (C_t). So, $I_{ec} = s.A_{ew}.S_{eg}.C_t$
ix. During production some waste will be come out from production house which may dispose off. So waste disposal cost arises. Hence waste disposal cost is a function of waste disposal cost per ton(w_c), the average weight of solid waste produced per unit product (b), and total production per cycle.
x. There is no shortage throughout the cycle.

DEVELOPMENT OF THE MODEL:

The study is considered as a production of a single type of item that is deteriorated at a constant rate. In this manufacturing process, the system produces both good and defective quality units with emission of CO_2. A carbon tax regulation penalizes the party that emits greenhouse gases. The model of deteriorating items with a certain percentage of defective products and having no shortage can be presented in figures. Fig. 1 represents the EPQ model with good products. At time $t = 0$, the production starts and hence the initial inventory level is zero. The inventory of good products increases at a rate $(1-x)p - d$ and achieves the peak at time $t = T_1$ with level of inventory I_p. However, the inventory level of defective products that is shown in fig.2, increases at a rate xp. The production process is continued until the warehouse is completely filled up. Then the production process is stopped. Let at $t = T_1$ the production is ceased. There after the inventory of good products starts depicted due to customer's demand as well as deterioration. It is assumed that a time $t = T_1$, the defective products are separated and at $t = T$, inventory level becomes zero.

Total production quantity per cycle is

$$q_0 = pT_1 \quad (1)$$

and total good products per cycle is

$$q = (1-x)pT_1 \quad (2)$$

Hence, the system of differential equations that governs the transition are given by

$$\frac{dI_{g1}(t)}{dt} = (1-x)p - d - \theta I_{g1}(t), \quad 0 \le t \le T_1 \quad (3)$$

$$\frac{dI_{g2}(t)}{dt} = -d - \theta I_{g2}(t), \quad T_1 \le t \le T \quad (4)$$

with conditions

$$I_{g1}(0) = 0,\ I_{g1}(T_1) = I_p,\ I_{g2}(T_1) = I_p,\ I_{g2}(T) = 0 \quad (5)$$

Solving (3) and (4) with boundary conditions (5), we have the inventory level function of good products at any time t as follows

$$I_{g1}(t) = \frac{(1-x)p-d}{\theta}\left(1 - e^{-\theta t}\right), 0 \le t \le T_1 \quad (6)$$

$$I_{g2}(t) = \frac{d}{\theta}\left(e^{\theta(T-T_1-t)} - 1\right), T_1 \le t \le T \quad (7)$$

At time $t = T_1$, we have from (5)

$I_{g1}(T_1) = \frac{(1-x)p-d}{\theta}\left(1-e^{-\theta T_1}\right)$

i.e., $I_p = \frac{(1-x)p-d}{\theta}\left(1-e^{-\theta T_1}\right)$ (8)

At time $t = T_1$, (5) and (7) yields

$I_{g2}(T_1) = \frac{d}{\theta}\left(e^{\theta(T-T_1)}-1\right)$

i.e.,$= \frac{d}{\theta}\left(e^{\theta(t-T_2)}-1\right)$ (9)

From (8) and (9), we have

$\frac{(1-x)p-d}{\theta}\left(1-e^{-\theta T_1}\right) = \frac{d}{\theta}\left(e^{e^{\theta(T-T_1)}}-1\right)$ (10)

Assuming θT_1 very small and neglecting the higher power of θ, we get the approximate value of T_1 as

$T_1 = \frac{d(T-T_1)}{(1-x)p-d}\left(1+\frac{\theta T_2}{2}\right)$ (11)

Since $T = T_1 + T_2$

$T = \frac{(T-T_1)}{(1-x)p-d}\left((1-u)p+\frac{\theta(T-T_1)}{2}\right)$ (12)

From fig.1, the good product per cycle is

$I_g(t) = \int_0^{T_1} I_{g1}(t)dt + \int_0^{(T-T_1)} I_{g2}(t)\,dt$ (13)

Hence from (6) and (7),

$I_g = \int_0^{T_1} \frac{(1-x)p-d}{\theta}\left(1-e^{-\theta t}\right)dt + \int_0^{(T-T_1)} \frac{d}{\theta}\left(e^{\theta((T-T_1)-t)}-1\right)dt$

$= \frac{(1-x)p-d}{\theta^2}\left(\theta T_1 + e^{-\theta T_1}-1\right) + \frac{d}{\theta^2}\left(e^{\theta(T-T_1)}-\theta(T-T_1)-1\right)$ (14)

Using Taylor's series expansion of series and neglecting higher power of θ, we get

$I_g = \frac{(1-x)p-d}{\theta^2}\left(\theta T_1 + e^{-\theta T_1}-1\right) + \frac{d}{\theta^2}\left(e^{\theta(T-T_1)}-\theta(T-T_1)-1\right)$

$= \frac{(1-x)p-d}{\theta^2}\left(\frac{\theta^2 {T_1}^2}{2}-\frac{\theta^3 T_1^3}{6}+\cdots\right) + \frac{d}{\theta^2}\left(\frac{\theta^2(T-T_1)^2}{2}+\frac{\theta^3(T-T_1)}{6}+\cdots\right)$

$= \left((1-x)p-d\right)\left(\frac{T_1^2}{2}-\frac{\theta T_1^3}{6}+\cdots\right) + d\left(\frac{(T-T_1)^2}{2}+\frac{\theta(T-T_1)^3}{6}+\cdots\right)$

$= \frac{(1-x)p-d}{\theta^2}\left(1-\frac{\theta T_1}{3}\right)T_1^2 + \frac{D}{2}\left(1+\frac{\theta(T-T_1)}{3}\right)(T-T_1)^2$ (15)

(Neglecting higher power of θ)

Let I_d is the inventory level of defective products at any time $t\,(0 < t < T_1)$, hence the corresponding differential equation is as below:

$\frac{dI_d(t_1)}{dt_1} = xp - \theta I_d(t_1),\ 0 \le t_1 \le T_1$ (16)

For $I_d(0) = 0$, solving (16), the inventory level of defective products at any time t is

$I_d(t_1) = \frac{xp}{\theta}\left(1-e^{-\theta t_1}\right), 0 \le t_1 \le T_1$ (17)

The inventory of defective products per cycle is

$I_d = \int_0^{T_1} I_d(t)dt = \frac{xp}{\theta}\int_0^{T_1}(1-e^{-\theta t})\,dt = \frac{xpT_1}{\theta} + \frac{xp}{\theta^2}\left(e^{-\theta T_1}-1\right)$ (18)

Using Taylor's expansion of series and neglecting higher power of θ, we get

$I_d = \frac{xpT_1}{\theta} + xpT_1\left(\frac{T_1}{2}-\frac{\theta T_1^2}{6}-\frac{1}{\theta}\right)$ (19)

From the figures, the total deteriorated items per cycle can be formulated as follows

$[(1-x)pT_1 - d(T_1+T_2)] + \left[xpT_1 - \frac{xp}{\theta}\left(1-e^{-\theta T_1}\right)\right]$

$$= (1-x)pT_1 - d(T_1+T_2) + xpT_1\left(2-\frac{\theta T_1}{2}\right) \quad (20)$$

Total cost per unit time is as follows

$$Total\ cost = \frac{1}{T}\begin{bmatrix} Set\ up\ cost + Production\ cost + Quality\ inspection\ cost \\ +Holding\ cost + Deterioration\ cost + Waste\ disposal\ cost \end{bmatrix}$$

$$= \frac{1}{T}\begin{bmatrix} S_c + (P_c+P_{ec})pT_1 + (q_c + x_c pT_1) + (h_{c1}+I_{ec})\left(\begin{matrix}\frac{(1-x)p-d}{2}\left(1-\frac{\theta T_1}{3}\right)T_1^2 \\ +\frac{d}{2}\left(1+\frac{\theta T_2}{3}\right)T_2^2\end{matrix}\right) \\ +(h_{c2}+I_{ec})\left(\frac{xpT_1}{\theta} + xpT_1\left(\frac{T_1}{2}-\frac{\theta T_1^2}{6}-\frac{1}{\theta}\right)\right) + w_c bpT_1 \end{bmatrix} \quad (21)$$

Let us consider the expected value of x, Equation (21) becomes

$$TEC = \frac{1}{T}\begin{bmatrix} S_c + (P_c+P_{ec})pT_1 + (q_c + x_c pT_1) + (h_{c1}+I_{ec})\left(\begin{matrix}\frac{(1-E[x])p-d}{2}\left(1-\frac{\theta T_1}{3}\right)T_1^2 \\ +\frac{d}{2}\left(1+\frac{\theta T_2}{3}\right)(T-T_1)^2\end{matrix}\right) \\ +(h_{c2}+I_{ec})\left(\frac{E[x]pT_1}{\theta} + E[x]pT_1\left(\frac{T_1}{2}-\frac{\theta T_1^2}{6}-\frac{1}{\theta}\right)\right) + w_c bpT_1 \end{bmatrix} \quad (22)$$

The expected total carbon emission (ETCE) can be derived from total production and inventory equations as follows:

$$ETCE = \frac{1}{T}\begin{bmatrix} A_{ep}.S_{eg}.pT_1 + s.A_{ew}.S_{eg}\left(\frac{(1-E[x])p-d}{2}\left(1-\frac{\theta T_1}{3}\right)T_1^2\right) \\ +s.A_{ew}.S_{eg}\left(\frac{E[x]pT_1}{\theta} + E[x]pT_1\left(\frac{T_1}{2}-\frac{\theta T_1^2}{6}-\frac{1}{\theta}\right)\right) \end{bmatrix} \quad (23)$$

For minimizing total expected cost(TEC) , the value of T_1 can be obtained from the equation

$$\frac{dTEC}{dT_1} = 0 \quad (24)$$

Subject to the condition

$$\frac{d^2TEC}{dT_1^2} \geq 0 \quad (25)$$

Example with numerical values

We consider an example providing numerical values to certain parameters with appropriate units. Let us consider$p = 200,\ d = 12, E[x] = 0.19,\ S_c = 22,\ P_c = 8,\ q_c = 11,\ x_c = 0.12,\ h_{c1} = 2.6, h_{c2} = 0.6 d_c = 2.5,\ w_c = 0.6, b = 0.3, \theta = 0.2, A_{ep} = 80, A_{ew} = 8, S_{eg} = 0.0005,\ s = 1.7, P_{ec} = 3, I_{ec} = 0.51$. By using Mathematica 11.1 software, we get the optimum value of $T_2 = 0.42$ year, $T_1 = 0.33$year, $T = 0.75$ year, $q_0 = 40.27104$ units, $q = 32.61$ units with $TEC = \$661.996$ per year and $ETCE = 2.15$ tons per year.

Sensitivity analysis

It is very important in a production inventory system for a producer to know the behavior of the system parameters which impacted upon the total expected cost function. Henceforth to illustrate the applicability of the model and to locate some significant managerial ramifications in the production houses, we study sensitivity analysis with the variation of different parameters.

Managerial insights

The following managerial phenomena are observed:

(i) TEC increases with increase in value of system parameters.

(ii) $ETCE$ increases with increase in value of parameters like S_c, (θ), and probability of defective products per cycle (x) and decreases with increases in the value of parameters customer demand (d), production rate (p), unit production cost (P_c) and fixed inspection cost for quality check(q_c).

(iii) The decision variable T_2increases with increases in the value of production rate $(p)$and set up cost (S_c) and decreases with increases in the value of customer demand (d), fixed inspection cost for quality check(q_c), inspection cost per unit (x_c), deterioration cost(θ),unit production cost (P_c), and probability of defective products per cycle (x).

(iv) The decision variable q_0(total production quantity per cycle) increases with increase in the value of customer demand (d) and inspection cost (x_c). However, decreases with the increases of the values of the parameters production rate (p), production cost (P_c), set up cost (S_c), fixed inspection cost for quality check(q_c), probability of defective products per cycle (x), and deterioration cost(θ).

CONCLUSION AND SCOPE

In every manufacturing system, the machinery produces both perfect and imperfect products. Imperfect products get loss to the manufacturer. Further the machinery as well as warehouses emits CO_2. For this the manufacturer pays a huge amount of carbon emission tax. In this study, we examine an economic production quantity model of constant deteriorating items with low carbon reduction. The model so framed that the total carbon emission cost and total operation costs are minimized. To ensure excellent service and avoid lost sales, the model does not allow shortages. The production rate is more than that of customer demand is considered, incorporation with deterioration, defective products and waste disposal. From the numerical example and sensitivity analysis it is observed that the result confirms the influence of CO_2 tax regulation is reduced. The proposed inventory model can be extended further in many ways. The present model can be formulated as considering reparable items with uncertain lead time. Another possible extension can be done by implementing technologies to reduce the imperfect products.

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Table 1: Result of sensitivity analysis

		T_2	T	T_1	q_0	q	$ETEC$	TEC
d	36	0.4821	0.6826	0.2005	24.06	19.48	2.1532	661.086
	38	0.4646	0.7062	0.2831	33.97	27.51	2.1522	661.389
	40	0.4482	0.7315	0.2833	33.99	27.53	2.1512	661.692
	43	0.4253	0.7730	0.3477	41.72	33.80	2.1497	662.147
	100	0.4107	0.8981	0.4874	48.74	39.48	2.2047	668.337
	110	0.4108	0.8164	0.4056	44.63	36.15	2.1979	676.503
p	118	0.4231	0.7688	0.3457	40.79	33.04	2.1500	661.232
	125	0.4310	0.7358	0.3047	38.09	30.85	2.0959	648.946
S_c	17	0.3989	0.7146	0.3156	40.57	32.86	2.1458	655.267
	19	0.4128	0.7398	0.3270	39.24	31.79	2.1463	658.016
	23	0.4262	0.7643	0.3381	37.57	31.24	2.1508	663.293
p_c	6	0.4454	0.7995	0.3540	49.48	34.41	2.1542	555.733
	7	0.4428	0.7876	0.3486	41.84	33.89	2.1531	715.103
	9	0.4268	0.7654	0.3386	40.63	32.91	2.1509	715.068
q_c	9	0.4392	0.7881	0.3488	41.86	33.91	2.1531	659.446
	10	0.4262	0.7643	0.3301	40.57	32.86	2.1508	660.676
	11	0.4231	0.7587	0.3355	40.27	32.61	2.1502	661.996
	12	0.4262	0.7643	0.3381	40.57	32.86	2.1501	663.293
x_c	0.10	0.4501	0.7494	0.2993	35.92	29.09	1.9434	607.205
	0.13	0.4446	0.7572	0.3126	37.51	30.38	2.2682	624.241
	0.14	0.4427	0.7601	0.3173	38.07	30.84	2.2708	630.175
θ	0.10	0.4747	0.8445	0.3698	44.37	35.94	2.1317	654.793
	0.22	0.4258	0.7649	0.3391	40.70	32.96	2.1556	663.314
	0.30	0.4013	0.7251	0.3237	38.85	31.47	2.1694	668.413
	0.35	0.3883	0.7038	0.3155	37.86	30.67	2.1774	671.415

x	0.10	0.4501	0.8003	0.3501	42.02	34.03	2.1339	657.514
	0.12	0.4465	0.7953	0.3488	41.86	33.90	2.1376	658.400
	0.14	0.4427	0.7901	0.3473	41.68	33.76	2.1411	659.252
	0.16	0.4389	0.7845	0.3456	41.48	33.59	2.1445	660.089

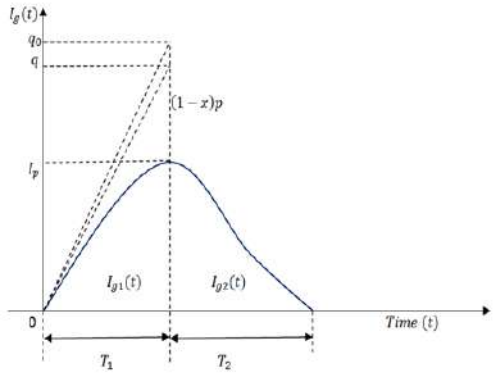

Fig. 1 The graphical representation of EPQ model: inventory versus time

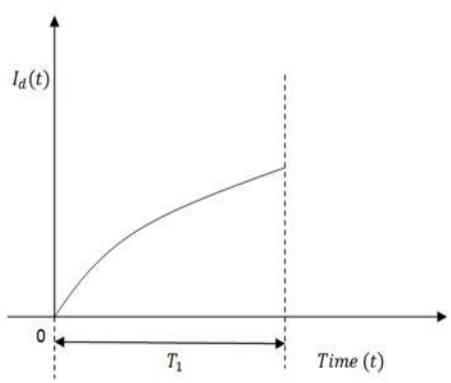

Fig. 2 The EPQ inventory model with defective products versus time

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REVIEW ARTICLE

A Review of Hetero Cyclic Compounds and Their Biological Activities

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ABSTRACT

Today, a large number of heterocyclic compounds have been identified, and this number is continually growing due to extensive synthetic research and the synthetic value of these molecules. Because of the distinctiveness of their structural Skelton elements, they are important in the biological system. Nucleic acid, vitamins, antibiotics, hormones, and other natural products contain them. Heterocyclic compounds comprising nitrogen, oxygen, and sulphur are an important class of heterocyclic molecules that have made substantial contributions to medical chemistry. Most biologically active heterocyclic substances that have recently been synthesised or isolated from plants, such as antifungal, anti-inflammatory, antibacterial, antioxidants, antiallergic, herbicidal, and anticancer compounds, are covered in this review.

Keywords: Heterocyclic, biological activities, metal complexes, anticancer etc.

INTRODUCTION

We all are familiar with carbocyclic compounds i.e. those compounds which have cyclic ring of carbon atoms. If this ring contains one or few carbon atoms replaced by other atoms like N,P,S etc than these compounds are called as heterocyclic compounds[1]. One of the most significant areas of organic chemistry research is heterocyclic chemistry. The conventional organic category of chemistry known as heterocycles is the most significant, and because of its structural Skelton components, they have enormous physiological and industrial significance[2]. Heterocycles make up the majority of pharmaceutical medicines that imitate biologically active natural compounds[3]. Heterocyclic materials account for more than half of all natural products. Heterocyclic small molecules make up the majority of medicines. Despite their relevance, chemists' understanding of heterocyclic molecules is frequently lacking[4]. All live cells' metabolism depends heavily on heterocyclic compounds, many of which are five- and six-membered molecules with one to three heteroatoms in the nucleus[5]. (World Health Organization data available on October 25,

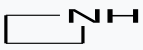
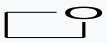
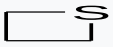
2020) Viruses are the most common infectious pathogens worldwide, and due to the coronavirus pandemic that lasted for about a year there is still continuous virus-human contact [6]. More than 28,700 cases and almost 11,300 fatalities were attributed to the ebolavirus-caused hemorrhagic fever pandemic in West Africa between 2013 and 2015, according to the World Health Organization[7]. The direct-acting antivirals (DAA) that are currently used to treat viral infections include ACH-1625, MK-5172 BMS 650032, Boceprevir, Telaprevir,, TMC435, Vaniprevir, Danoprevir, ABT-450, BIT225, and GS-9256. These N-heterocyclic compounds are antivirals with a virucidal mechanism of action, and have positive feedback[8-10].So nitrogen containing heterocyclic compounds have potential activity as antiviral agents[11]. It is well recognised that some heterocyclic nitrogen-containing chemicals are extensively distributed in nature and necessary for life in diverse ways, making them significant in pharmaceutical and pesticide chemistry[12-13].
The word heterocyclic is combination of two sub parts –

HETERO + CYCLIC
Hetero is derived from greek word heteros meaning different
And cyclic is derived from greek word KYKLOS means circle. So heterocyclic means cyclic compounds having different atom or atoms. classification of hetero cyclic compounds

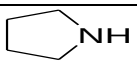
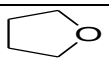
3-membered rings with one heteroatom[14]

Heteroatom	Name	Structure
Nitrogen	Aziridine	
Oxygen	Oxirane	
Sulfur	Thiirane	

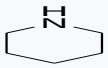
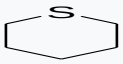
4-membered rings with *one* heteroatom

Heteroatom	Name	Structure
Nitrogen	Azetidine	
Oxygen	Oxetane	
Sulfur	Thietane	

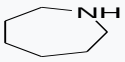
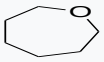
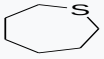
5-membered rings with *one* heteroatom

Hetroatom	Name	Structure
Nitrogen	*Pyrrolidine*	
Oxygen	*Tetrahydrofuran*	
Sulfur	Tetrahydrothiophene	

6-membered rings with *one* heteroatom

Heteroatom	Name	Structure
Nitrogen	*Piperidine*	
Oxygen	Oxane	
Sulfur	Thiane	

7.Memberedrings with one heteroatom

Heteroatom	Name	Structure
Nitrogen	Azepane	
Oxygen	Oxepane	
Sulfur	Thiepane	

8.Memberedrings with one heteroatom

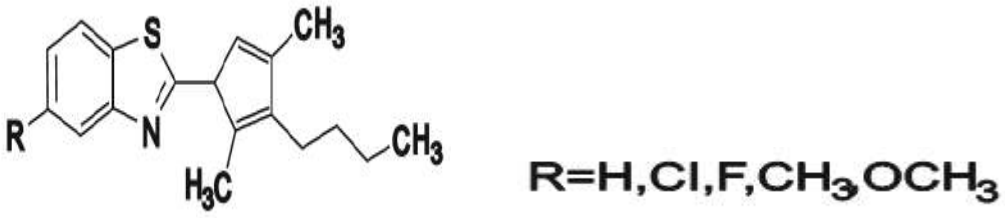
Heteroatom	Name	Structure
Nitrogen	Azocane	
Oxygen	Oxocane	
Sulfur	Thiocane	

Complexes and uses of Heterocyclic Compounds

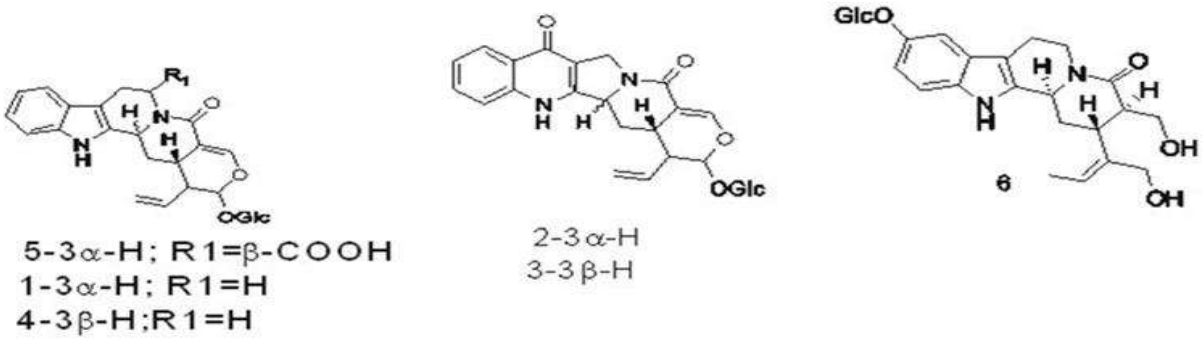
Anti-Inflammatory

Anti-inflammatory properties the ability to reduce inflammation refers to substances that are used to treat or reduce swelling or inflammation. Anti-inflammatory ingredients are frequently included in analgesics. It lessens inflammation, as opposed to narcotic medicines, which affect the central nervous system and stop pain signals from reaching the brain. The three anti-inflammatory pharmaceuticals that are most frequently used are aspirin, ibuprofen, and naproxen; this family of anti-inflammatory drugs is known as NSAIDs (non-steroidal anti-inflammatory drugs), which sets them apart from steroids. These medications' activities are based on a mechanism of action. Inhibiting the activity of Cyclooxygenase (COX) enzymes is one example. These enzymes are involved in the metabolism of arachidonic acid. Certain NSAIDs may target the isoenzymes of cyclooxygenase. Sawhney and

Bhutani [15] synthesised a novel 2-(2-benzothiazolyl)-6- aryl-4, 5-dihydro-3(2 H)-pyridazinone and discovered it to be useful.



Li et al. [16-17] have extracted six compounds *Nauclea officinalis* (Pierre ex Pit.) and compared the activity of it



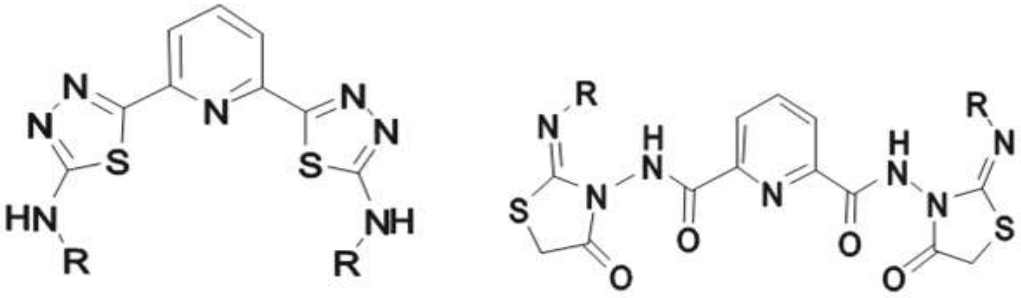
Aspirin, ibuprofen, and naproxen are a few typical NSAIDs. The more recent specific COX-inhibitors are not categorised alongside the older NSAIDs, while likely sharing a similar mode of action. Long-term usage of NSAIDs may result in gastric erosions, which may progress to stomach ulcers and, in severe cases, fatal haemorrhages[18].

Anticancer properties

Cancer is a phrase that refers to a group of disorders that are characterised by abnormal cell growth and the ability to infiltrate or spread to other sections of the body. This condition is brought on by a number of factors. Chemical molecules and radiation energy, to name a few. To treat this condition, a variety of drugs are employed. Initially cis platin drug was used. To cure this illness, cancer cells must be killed or their growth must be slowed. We'll go over the most important points. Recently developed synthetic compounds have been used for this purpose. "Synthesized 6-OH-Phenanthroquinolizidine alkaloid and its derivatives," according to Liu et al. . which have a potent anticancer effect by slowing the cell's S phase growth.". The anti-cancer properties of benzothiazoles containing phthalimide were investigated by Stanton HLK, et al. using human carcinoma cell lines[19]. In order to visualise tyrocinekinese in cancer using protein emission tomography (PET), Wang M. et al. have created fluorinated2-aryl benzothiazoles that are carbon 11 tagged.

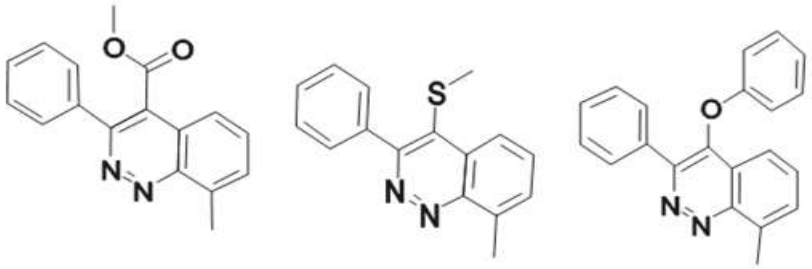
Antifungal properties

It is a phrase for medications or treatments applied to a fungal infection that frequently impacts the skin, hair, and nails. For instance, ringworm and athlete's foot are both typical fungal infections. Antifungal drugs kill fungal cells by changing their chemical composition. The cell membrane tears, allowing its contents to leak out and the cell to perish . Another approach is to stop fungus cells from growing and proliferating. A was produced by Molnar et al [20]"a number of derivatives of dipicolinic acid, some of which show potential. Aspergillus flavus, Aspergillus ochraceus, and the Fusarium species Fusarium verticilioides and Fusarium graminearum have antifungal activity." Against a Fungal Strain, Antifungal Activity Antifungal Activity.



Herbicidal activity

Several heterocyclic derivatives have this property, and we will examine some of the most recently synthesised compounds of this sort. Many chemicals have this property, and they can destroy undesirable plants and grasses without damaging food crops. In a study by Wang et al. [8], fluorin-containing 2- (substituted phenoxybutyryloxy) alkyl-5,5-dimethyl-1,3,2- dioxaphosphinan-2-one and a- [(substituted phenoxybutyryloxy or valeryoxy)] alkylphosphonates were produced. Herbicidal effects of these substances have been observed in some species of weeds were evaluated in a green house .Ana and Luminita [21] studied fused heterocyclic as herbicide inhibitors of D1 protein in photosystem II of plants using molecular docking and Quantitative Structure-activity Relationship (QSAR). Here's one on the substances under investigation.



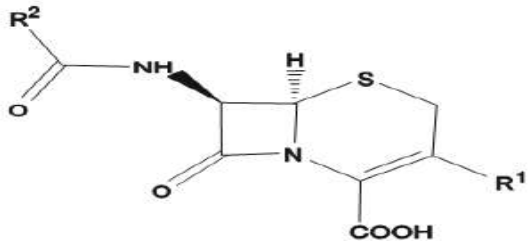
Antibacterial properties

Antibacterials, often known as antibiotics, are medications that are used to prevent or cure bacterial illnesses by either killing or inhibiting the growth of bacteria. So on this basis they can be of two types

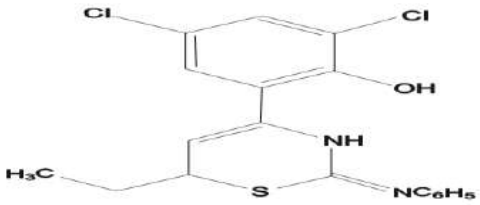
1. BACTEREOSIDAL- Those which kills bacteria
2. BACTEREO STATIC- Those which inhibits growth of bacteria

Antiprotozoal action was occasionally linked to drug use. In the fight against viral diseases like the common cold and influenza, antibiotics are worthless. Antibiotic misuse could promote the development of resistant microorganisms. improper. Antibiotics are categorised based on their chemical composition or modes of action. heterocyclic aromatic Since derivatives, like -lactam derivatives, play a significant role in the chemical structure of antibiotics, many researchers have studied them. synthesis This kind of impact, which has been investigated on a

variety of microorganisms, is exhibited by several substances. New pyrimidine and 1,2,3,4-tetrazole derivatives based on sulfadiazine were created by Abbass and Zimam [22], who then tested these substances on two different types of bacteria: Streptococcus spp. (Gram-positive bacteria) and Porphyromonas gingivalis (Gram-negative bacteria). 1,3-thiazines-based heterocycles confirmed antibacterial efficacy against a variety of microorganism strains, according to Damanjit (2013) [23].

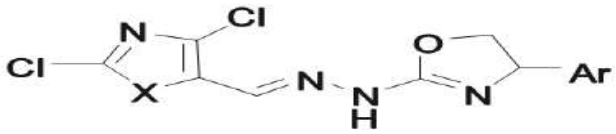


1,3-thiazines produced from chalcones have antibacterial action against Pseudomonas aeruginosa, Staphylococcus aureus, Bacillus subtilis, and Escherichia coli, according to Yavari and Hossaini (2010) [24]. Substituted 1,3-thiazines have been discovered to have antimycobacterial action, according to Ram and Parhate (2013). Antibacterial activity against a few common bacteria was tested in the investigations [25].

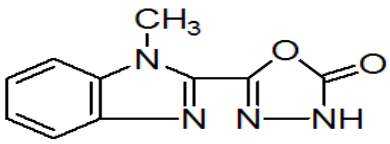


Antiallergic

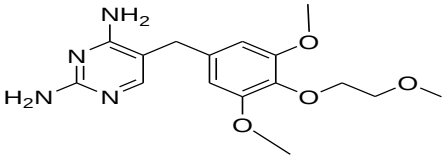
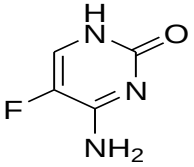
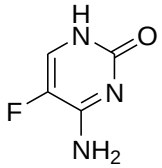
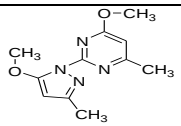
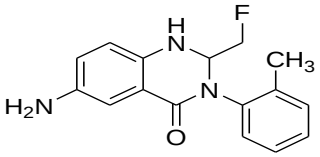
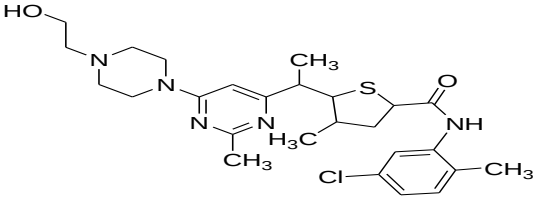
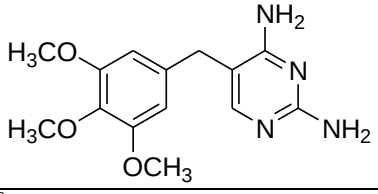
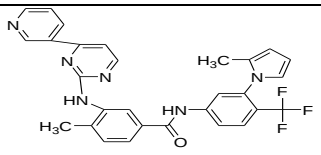
Many synthetic heterocyclic compounds showed antiallergic effectiveness when they were investigated. Putta et al. synthesised new bis-heteroarylhuydrazines as potent anti-allergic medications. These compounds are nontoxic to cells at 50 and 100 M, and they also effectively prevent the release of -hexosaminidase induced by immunoglobulin E/silver at these concentrations.

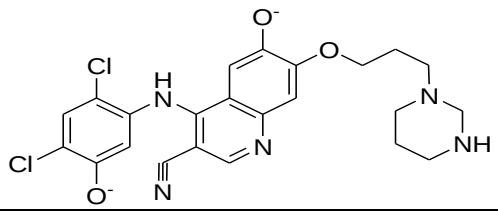


Khandwala et al have synthesized 1-menthyl-2-[1,3,4-oxadiazol-2(3H)-one-5-yl] benzimidazole and related compounds as antiallergic agents.



Some Examples Of Hetero Cyclic Compounds With Activity And Structure

Biological function	Name	Structure
Anti-bacterial	Tetroxoprim[26]	
Antifungal	Flucytosine[27]	
Anti-inflamatory	Celecoxib[28]	
	Epirizole[29]	
	Afloqualone[30]	
Anti-cancer	Dasatinib[31]	
	Trimephoprim[32]	
	Nilotinib[33]	

	Bosutinib[34]	

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RESEARCH ARTICLE

Anti Tubercular Drugs Induced Steven Johnson Syndrome / Toxic Epidermal Necrolysis

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ABSTRACT

Steven Johnson Syndrome\Toxic Epidermal Necrolysis (SJS/TEN) is a potentially fatal mucocutaneous reaction, which is characterized by dermatological and systemic manifestations. Tuberculosis caused by gram positive mycobacterium tuberculosis, which can be managed by anti-tubercular drugs. However, these drugs may lead to ADR like liver toxicity, exanthematous pustulosis, SJS/TEN, DRESS .Here we present a case of anti-tubercular drugs (AKT-4 regimen) induced SJS/TEN in a 56-year-old female patient who presented with complaints of oral ulcer, blisters over the lower limb, buttocks and neck region, fever, pruritus, and urticaria. She was managed in intensive care unit with IV antibiotics, systemic and topical steroids and anti-histamines. Patient condition was improved and discharged. Clinicians and clinical pharmacist should be aware of these manifestations and about the timely management to be given. The patient should be informed regarding the possible reactions and advised them to seek medical attention to prevent further complications.

Keywords: SJS/TEN, adverse drug reaction, T.B. anti-tubercular drugs. Urticaria anti-tubercular drugs induced Steven Johnson Syndrome/Toxic Epidermal Necrolysis in a 56- year-old female patient and its management

INTRODUCTION

SJS/TEN is a rare severe mucocutaneous reaction delineated by systemic and dermatological reactions[1], whereas cutaneous pain is an important early clinical symptom in SJS/TEN and others include fever, malaise, upper respiratory tract symptoms followed by eruption of skin.[2] In general, about 2 to 7 cases of SJS/TEN per million are reported per year.[3] Presentation of epidermal detachment is much greater in TEN than in SJS.[4] In SJS about 10% of epidermal detachment is seen. SJS/TEN also affects multiple organs such as liver, lungs and kidney.[5] It affects any age group but more commonly in women and total mortality rate due to SJS was reported to be 10%.[6] First case of SJS was reported in two young boys in 1922.[7] Alan Lyel reported TEN in four patients with skin eruptions mimicking scalding of skin in 1956.[8] Mainly certain groups of drugs like antibiotics, anticonvulsants, sulfonylureas, diuretics, analgesics, antidepressants, xanthine oxidase inhibitors, anti-tubercular drugs, ACE inhibitors precipitate SJS/TEN.[9] In addition to drugs, genetic factors, high dose of certain medications, Mycoplasma pneumonia infection, HIV infection are the major etiological factors behind this life-threatening condition.[5]

Tubercle bacillus or Koch's bacillus called as mycobacterium tuberculosis is the causative organism for tuberculosis (TB), discovered by Robert Koch in 1882.[10] It mainly spread through inhalation of fresh cough droplets or dried sputum of the infected person or via ingestion of the organism or inoculation of organism through skin leads to the development of infection. It can also be transmitted through the placenta from an infected mother to the fetus.[10] It is a major endemic in Asia mainly in India and China.[11] Based on 2015 WHO report global prevalence of TB was 142 per 100,000 cases [6]. Tuberculosis can also affect multiple organs other than lungs causing tuberculoma brain, tuberculous meningitis, tuberculous arthritis, tuberculous endometritis, tuberculous mastitis, renal tuberculosis etc. Diagnostic test includes acid fast bacillus microscopy of sputum, polymerase chain reaction, mycobacterium culture, radiological procedures, Mantoux skin test, serological tests, and fine needle aspiration. Pulmonary insufficiency, sepsis, cor-pulmonale and pulmonary hemorrhage are the cause of death in pulmonary tuberculosis patients [10]. According to WHO an Adverse Drug Reaction (ADR) is defined as ''any response to a drug that is noxious, unintended and that occurs at doses normally used in the man for the prophylaxis, diagnosis or therapy of disease or for the modification of physiological function".[12] There are few case reports on anti-tubercular drugs induced SJS/TEN, here we report a case on SJS/TEN induced by anti- tubercular drugs.

Case report

A 56-year-old female patient presented in the general medicine department on 22/04/2022 with the complaints of pruritus, blisters over lower limbs, neck, buttocks and also had oral ulcers, scaling of skin over lower limb(fig.1), scaling of skin over neck (fig.2), scaling of skin over abdomen(fig.3), scaling of skin over upper back region(fig.4) and urticaria. She was admitted in the medical ICU for the initial care and assessment. She had history of DM for 10 years, hypertension for 15 years. she underwent pericardiocentesis on 1/03/2022 and on 9/03/2022 wherein 500 ml and 375 ml of fluid respectively was drained. She was tested positive for covid on 16/02/2022 and became negative after 7 days. She had history of contrast induced Acute kidney injury (AKI) and underwent hemodialysis for 5 days from 25/02/2022. Lymph node biopsy from inguinal region was done on 10/03/2022 and was suggestive of tuberculosis. Her past medications included Tab. Amlodipine 5mg bd, Tab. Bisoprolol 5mg bd, Tab. Diazepam 5mg od, Inj. Human Mixtard 30-0-18 units, Tab. Prednisolone 5 mg od. On 11/03/2022 she was started on Tab AKT-4 (isoniazid 300mg od, pyrazinamide 500mg bd, rifampicin 450 mg od, ethambutol 800mg od) after tested positive for TB, discontinued AKT on 12/03/22 prior to creation of pleuro-pericardial window, again restarted on 16/03/22 after the procedure, she was discharged from the hospital on 21/03/22, later after 4 days developed pruritus managed with Tab. Avil and discontinuation of AKT. When patient was symptomatically better, rifampicin and ethambutol were restarted alternatively for seven days after that pyrazinamide and isoniazid was added. After 2 weeks patient again developed pruritus all over the body along with oral ulcers, and urticaria, re-visited the hospital and admitted in ICU with the complaints of blisters over lower limbs, buttocks region and neck, swollen lips, scaling of skin, fever. Lab reports showed elevated CRP-196.2mg/l, ESR-75 mm/hr, D-Dimer 888ng/ml, FBS-162mg/dl, LFT and RFT within normal limits. Her vitals on 22/04/2022 were Blood pressure (BP) 140/90 mmHg , temperature 38^0 C, heart rate 86

beats/min and respiratory rate 20 breaths/min. Dermatology consultation was done and skin biopsy from the neck and abdomen was taken which showed epidermis with necrotic keratinocytes , focal full thickness epidermal necrosis, basal cell vacuolization and sub epidermal bullae formation, hyperkeratosis and para-keratosis .Dermis shows moderate or dense infiltrate composed of lymphocytes, neutrophils and occasional eosinophils features suggestive of SJS/TEN .The reaction was analyzed using Naranjo ADR probability scale ,WHO-UMC causality scale and Hardwig's Severity assessment scale .Based on Naranjo scale it scored 7 (Table-1) and the ADR is probable in nature. By using Hardwig's severity assessment scale it was at level 4(moderate level) ADR. Causality was probable based on WHO-UMC scale.

Management

SJS/TEN was managed initially by withholding the offending drug, IV fluids, IV antibiotics- Inj. CEFOPERAZONE and SULBACTAM 1.5 gm IV BD are continued till discharge, systemic steroids-Inj. Methyl Prednisolone 500 mg OD for 3 days and later switched to T. Prednisolone 60 mg OD, then tapered to 40 mg OD and later 30 mg. Urine culture and sensitivity was done on 22/04/2022 and which yielded heavy growth of klebsiella pneumonia, sensitive to AMIKACIN and GENTAMYCIN with same MIC value of < 1 and moderately sensitive to COLISTIN AND IMEPENEM. Patient was treated with Inj. AMIKACIN 500 mg OD for 10 days. Pus culture from skin was done on 26-04-2022 which yielded scanty growth of klebsiella pneumonia, moderately sensitive to only Inj. AMIKACIN and COLISTIN. Liquid paraffin and H.H FUDIC CREAM (MOMETASONE and FUSIDIC ACID) twice daily were advised for local application, vaseline for lip care, moxifloxacin eye drops TID for 7 days as prophylactic therapy. Antihistamines chlorpheniramine and hydroxyzine were also given to patient to reduce allergic reaction. Past medications except anti-tubercular drugs were continued during the hospital stay. She was discharged on 06/03/2022 with T. Pantoprazole 40mg BD for 7 days, T. Hydroxyzine 25mg BD for 7 days, T. Cefuroxime 500mg BD for 5 days, T. Prednisolone 20 mg OD for 1 day, H.H. Fudic cream for local application BD, liquid paraffin for local application TID, T. Vildagliptin 50mg OD, and was advised to continue her past medications except anti-tubercular drugs.

OUTCOME

She responded to therapy well and was symptomatically better. Vitals were stable and skin appeared to be better. Her lab investigation shows evident decrease in CRP levels from 196.2mg/l to 98.4mg/l, total count from 10100 cells/micro liter to 8800 cells/ micro liter, D-dimer 888ng/ml to 767ng/ml, ESR 115mm/hr to 104mm/hr.

DISCUSSION

SJS/TEN is a life threatening, mucocutaneous adverse reaction. It mainly affects the immunocompromised patients like HIV positive cases, patient on anticancer drugs, antimicrobials etc. It is usually seen in women than males [13]. According to international classification, the total body surface area affected by the TEN is more than 30 % while in case of SJS it is only about 10 % but both have almost same mortality rate, about 10 to 50 percentiles [9]. Presentation of symptoms may occur immediately after the administration or after a period of 45 days of initiating the therapy [14]. Similar case was published in 2020 by I Gusti Ayu Risma Pramita and Tjokorda Dalem pemayun *et al* in Intisari Sains Medis 2020 volume 11.[11] They reported a case of 53-year-old female patient with anti-tubercular drugs induced SJS, she was presented with complaints of dyspnoea, fatigue and erythema. Her past medications include Tab. Amlodipine for hypertension and Tab. Isoniazid, Tab. Ethambutol and Tab. Pyrazinamide for tuberculosis. She had a similar presentation including pruritus over the trunk and extremities along with oral mucositis.

In addition, she had hepatic failure with marked elevation of hepatic enzymes, hyponatremia, hypokalaemia, positive Hbs Ag and septic encephalopathy. Initially all the suspected drugs were stopped and managed with IV supports like nor epinephrine and dobutamine, topical and systemic steroids (IV-Methylprednisolone, dexamethasone and gentamycin topical applications), IV fluids and IV antibiotics, but her disease progressed and she was shifted to ICU where she was intubated and was on ventilator support. Over the course her condition worsened and eventually patient expired [11]. Different studies from various parts of the word illustrate different

class of drugs that induce SJS. It is evident that anti-microbials, NSAIDs and anti-epileptics are the major classes of drugs that induce SJS and TEN. Several analyses show among antimicrobials, SJS was induced mostly by fluoroquinolones (8.48%) and least by cephalosporins and anti-retroviral agents, 3.08% and 3.34% respectively. Meanwhile 5.65% of incidence were reported by use of anti-tubercular drugs and penicillin shares similar range of 5.39%. Several studies from three different countries Singapore, Japan and Togo, shows that the most common group of drugs that cause SJS were beta lactam antibiotics in Singapore, cephalosporin and sulphonamides in Japan and Togo. In the Indian scenario SJS was mostly reported with the use of Carbamazepine, Phenytoin and Paracetamol [15].

Identification and withdrawal of offending agent is the most important part in the management of SJS. General management includes use of fluids to maintain electrolyte balance, normal body temperature, liquid paraffin gauze for covering the skin, proper hygienic and aseptic condition for preventing further infections. Medical management includes IV antibiotics, steroids, immune modulators like cyclosporine, tacrolimus etc. IV N-acetyl cysteine and Recombinant granulocyte colony-stimulating factor (G-CSF) were found to be effective in re-epithelialization [16]. The expected outcome is to prevent mortality and to improve the quality of life by providing general and proper medical management. Timely intervention can improve the outcome, quality of and reduce the expenditure [13]. Patient and their family members should be informed about the offending drug as well as the importance of preventing re-exposure to the drug [17].

CONCLUSION

Compliance to the drugs is the key to complete remission of tuberculosis. However, clinicians and clinical pharmacists should be aware of possible side effects of anti-tubercular drugs and educate the patients regarding the same. This helps to improve compliance to the drugs and also helps to seek medical attention in case of any adverse events which eventually can prevent further complications, improve the quality of life, and reduce mortality.

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Table -1. Naranjo ADR probability scale.

Naranjo adverse drug reaction scale					
Sl.No	**Questions**	**Yes**	**No**	**Do not know**	**Score**
1	Are there previous conclusive reports on this reaction?	+1	0	0	+1
2	Did the adverse event appear after the suspected drug was administered?	+2	-1	0	+2
3	Did the adverse reaction improve when the drug was discontinued, or a specific antagonist was administered?	+1	0	0	+1
4	Did the adverse event reappears when the drug was re-administered?	+2	-1	0	+2
5	Are there alternative causes (other than the drug) that could on their own have caused the reaction?	-1	+2	0	0
6	Did the reaction reappear when a placebo was given?	-1	+1	0	0
7	Was the drug detected in blood (or other fluid) in concentration known to be toxic?	+1	0	0	0
8	Was the reaction more severe when the dose was increased or less severe when the dose was decreased?	+1	0	0	0
9	Did the patient have similar reaction to the same or similar drugs in any previous exposure?	+1	0	0	0
10	Was the adverse event confirmed by any objective evidence?	+1	0	0	+1
Total score: 7					

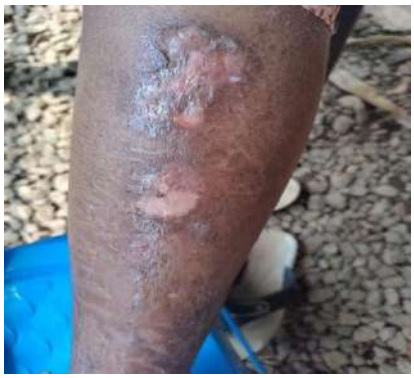

Figure 1: Scaling of Skin Over Lower Limb

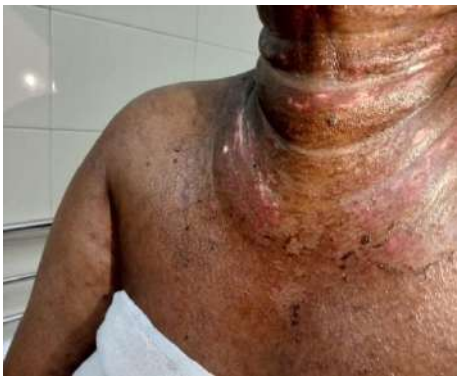

Figure 2: scaling of skin over neck

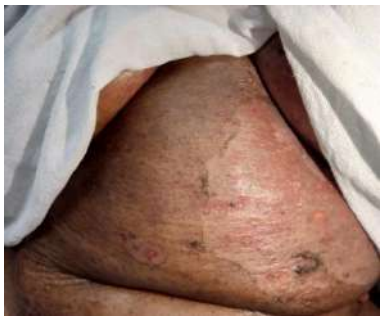

Figure 3: Scaling of Skin Over Abdomen

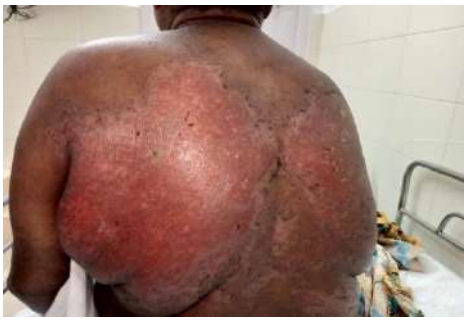

Figure 4: Scaling of Skin Over Upper Back Region

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RESEARCH ARTICLE

Arbuscular Mycorrhizal Fungi (AMF) Enhanced the Growth and Nutrient Content in Cowpea (*Vigna unguiculata*)

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ABSTRACT

The current study was planned with the goal of providing some insight into the influence of AMF on cowpea plants in pot trails. The pot culture experiment of cowpea were carried out for 90 days with three replicates each of three different treatments Glomus hoi (T1) Acaulospora kinentensis (T2) combinations of Glomus hoi+ Acaulospora kinentensis(T3) along with their control (T0). The plants were uprooted from each treatment after 30, 60 and 90 days of pot trials and analysed on morphological and biochemical parameters. The result showed that AM fungi inoculated plants improve their growth, plant biomass and biochemical properties as compared to control.

Keywords: Arbuscular mycorrhizal fungi, Biomass, Cowpea, Growth and Nutrients.

INTRODUCTION

Cowpea (*Vigna unguiculata* (L.) Walp.) is a popular food legume that grows in tropical and subtropical climates.In the Indian context, it is grown primarily in arid and semi-arid tracts of Punjab, Haryana, Delhi, and West UP, as well as a significant area in Rajasthan, Karnataka, Kerala, Tamilnadu, Maharashtra, and Gujarat.In Gwaliorfarmers grow it askharif crop (sowing begins in early June and lasts until the end of July and also in summer season[sowing begins from 2nd to 4th week of March (for grain), ist week of February (fodder) (Boukar et al, 2020). Cowpea is a member of the Fabaceae family. Cowpea is an annual herbaceous legume grown for its edible seeds or fodder. Cowpea plants are glabrous and herbaceous that grows erect, prostrate, or ascending and has a tap root system. Cowpea can reach a height of 80 cm, while climbing varieties can reach a height of 2 meters. The first pair of genuine leaves are simple and opposite, while the subsequent leaves are trifoliate with oval leaflets (6-15 cm long and 4-11 cm broad) and alternate, indicating epigeal germination.

Cowpea (*Vigna unguiculata* (L.) Walp.)

Kingdom : Plantae
Division : Magnoliophyta
Class : Magnoliopsida
Order : Fabales
Family : Fabaceae
Genus : *Vigna*
Species : *Vigna unguiculata* (L.) Walp.

In the present time there is an immense burden on global agricultural production due to the increasing population. The most important challenge in developing countries is to produce sufficient amount of food grains for the growing populations (Grote *et al*, 2021). Several techniques have been employed from time to time in order to increase the agricultural yield. Present day agriculture is totally dependent on chemical-based fertilizers, herbicides, and pesticides. Use of such chemical-based fertilizers is effective for increasing the production and productivity of crops, however, has very negative impact on soil health by altering the physical, chemical and biological properties of soil (Pal and Pandey, 2017).Hence for sustainable agriculture, all efforts should be streamlined to protect and maintain soil health. Biofertilizers are not only organic material resulted from animal residues, plant residues and so on. They also include products resulted from microbial activities in relation to nitrogen stabilization or phosphorus and other nutrient elements preparations that act in soil (Johnson *et al*, 2015). One of the available ways to attain sustainable agriculture is using some microorganisms that have important role in supplying food requirements like mycorrhizal fungi (Barea *et al*, 2002). Mycorrhiza is the mutualistic symbiosis between soil borne fungi with the roots of higher plants (Sieverding, 1991). Mycorrhizal associations involve three way interactions between host plants, mutualistic fungi and soil factors (Rigamonte *et al*, 2010). Arbuscular mycorrhizal fungi (AMF) are important soil microbes that belong to phylum Glomeromycota and form symbiotic association with the roots of 70-90% of all known vascular plant species. In this symbiosis, the host plant provides soluble carbon sources to the fungus which enhance the uptake of certain nutrients by roots and increase plant resistance against pathogens, improves plant tolerance to environmental stresses like drought and accelerates plant establishment (Smith, 2013).

MATERIALS AND METHODS

The certified seeds were procured from Rajmata Vijayaraje Scindia Krishi Vishwavidyalaya, Gwalior. Experiments were carried out for 90 days in pot trials with inoculation of AM fungi. Different treatments of AM fungi are given in table 1. The pot trial experiment was carried out in "Open air conditions at botanical garden of school of Studies in Botany Jiwaji University, Gwalior" to observe the response of cowpea with AM fungi.

Plant harvest and analysis

The experiment setup was planned to study various morphological and biochemical parameters on cowpea plants under pot trials filled with sterilized soil. The observations were taken on different parameters after completion of 30, 60 and 90 days of plant growth.

Growth and developmental studies of host plants

The morphological study was carried out on different parameters viz., The plant Shoot length, Plant width, Root length, Root length, Number of branches per plant and largest leaf area biomass (fresh and dry weight) and percent of mycorrhizal colonization at all stages viz, growth, reproductive and matuarity stage of host plant

A. The plant Shoot length: The plant length was measured with the help of inch tape from the rhizospheric region to top.
B. Plant width: The plant width was measured with the help of inch tape
C. Root length: Root length was measured with the help of inch tape from the rhizospheric region to top.

D. Number of branches per: the number of branches was counted.
E. Number of leaves per plant: The number of leaves was counted.
Largest Leaf area: was measured with the help of inch tape from base to top

Plant biomass (fresh and dry weight)
The root and shoot parts of the plants were separated. Roots were washed gently to remove all the adhering soil particles in running tap water. Both the samples were gently pressed in folds of filter paper to remove excess moisture. The fresh weight was determined and the samples were wrapped in paper bags and kept in a hot air oven at 50-60℃ for 24 hrs, removed, cooled in desiccators and dry weight was taken.

AM root colonization percentage
The Rapid Clearing and Staining Method of Phillips and Hayman (1970) were used to examine the mycorrhizal root colonisation percentage of collected host plant root samples.

Biochemical studies of host plants
The following parameters were observed in biochemical studies of AM fungi-treated plants.

Estimation of chlorophyll pigments
The Arnon (1949) method was used to examine the chlorophyll pigments in the fresh leaves of the host plant.

Estimation of total phenol content
The total phenolic content of host plant shoot and root parts was determined using the Bray and Thorpe method (1954).

Estimation of sugar content (total and reducing sugar)
The Nelson-Somogyi method was used to determine the total and reducing sugar contents in host plant shoot and root parts (Nelson, 1944).

Non-reducing sugar= Total sugar – Reducing sugar.

Estimation of protein
Total Protein analysis was analysed using the Standard Lowry's procedure (Lowry et al., 1951).

Statistical analysis
Statistical analysis was done to test the significant differences among different samples by analysis of variance (ANOVA) using sigma stat 3.5 software. Descriptive analysis with Normality test and equal variance test were also applied following Student-Newman-Keuls range test (SNK) to examine the difference at significance level of $p<0.05$.

RESULTS

The experiment was set up to look at various morphological and biochemical parameters on cowpea plants in pot trials.

Percentage root colonization
At vegetative stage, the maximum colonization 42±0.33% was in T3 and the lowest was 35±0.14% in T1. At flowering phase, the maximum colonization 71±0.97% was observed in T2 and minimum was 46±0.11in plants treated with T1. At matuarity stage, maximum colonization 76±1.11 cm was in T3 and minimum colonization was 69±0.25 cm in plants treated with T1.(Fig 4 and 5)

Growth and developmental parameters

AMF treated cowpea plants showed significant increase in growth and developmental characters i.e. shoot height, plant width and root length at every stage of growth i-e vegetative, reproductive and matuarity stage.(Table 2)

Chlorophyll contents

AMF treated cowpea plants showed significant increase in plant chlorophyll-a, chlorophyll-b and total chlorophyll at every stage of growth vegetative, reproductive and matuarity stage. At vegetative stage, total chlorophyll pigments in fresh leaves of chickpea was observed maximum 0.29±0.02 in T3treatment while as minimum 0.16±0.01 fresh weight in T0 treatment. At flowering stage, total chlorophyll pigments in fresh leaves of chickpea plant was observed maximum 0.33±0.01 fresh weight in T3 treatment and minimum total chlorophyll content was0.21±0.01 in T0. At matuarity stage, highest total chlorophyll pigment was 4.9±0.25 in T3 treatment and minimum was 3.67±0.21 in T0 (Table 3).

Plant biomass (fresh and dry weight)

Fresh weight

AMF treated cowpea plants showed significant increase in plant biomass (fresh weight and dry weight) at every stage of growth vegetative, reproductive and matuarity stage (Table 4)

Reducing Sugars

Plants which were inoculated with different species of AM fungi showed significant increase in reducing sugars in both parts of plant (root and shoot) at every stage of growth vegetative, reproductive and maturity stage (Table 5)

Non reducing sugars

Plants which were inoculated with different species of AM fungi showed significant increase in non reducing sugars in both parts of plant (root and shoot) at every stage of growth vegetative, reproductive and matuarity stage (Table 6).

Total sugars

Plants which were inoculated with different species of AM fungi showed significant increase in total sugars in both parts of plant (root and shoot) at every stage of growth i-e vegetative, reproductive and matuarity stage (Table 7)

Protein

Plants which were inoculated with different species of AM fungi showed significant increase in protein content in both parts of plant (root and shoot) at every stage of growth i-e vegetative, reproductive and matuarity stage (Table 8).

Phenol

In the present investigation it was observed that plants inoculated with different species of AM fungi showed significant increase in phenolic content in both analyzed parts (root and shoot) at every stage of growth vegetative, reproductive and matuarity stage (Table 9).

CONCLUSION

The findings show that combinations of Glomus hoi and Acaulospora kinentensis is the most effective AM fungal bio inoculants, yielding the highest yield of all the AM species treatments. In addition, when compared to the other AM fungal species used in the study, the ability to colonize and multiply the host root was the best. The control plants (T0) showed the least improvement in plant growth and biochemical properties. Based on the current findings, it can be concluded that inoculating AM fungi into host plants improves overall plant growth and biochemical parameters significantly. This study demonstrated a successful applied approach for the successful restoration of less fertile soils

This research will assist farmers for re-establishment of their unfertile land by the treatments with indigenous AM fungi. Our research showed an effective approach which can be applied for the improvement in soil health in unfertile lands which in turn increases production and productivity of several agricultural crops. The importance of AM fungi for sustainable agriculture and for the restoration of original quality of ecosystem can lead to its commercial use for the restoration of less fertile agricultural land.

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Table 1: Different treatments maintained with AM fungal species

S.no	Treatments	Treatment with AM Fungal species
1	Control	Without AM inoculation
2	T_1	*Glomus hoi* (single)
3	T_2	*Acaulospora kinentensis*(single)
4	T_3	*Glomus hoi* + *Acaulospora kinentensis*

Table 2: Growth and developmental parameters of cowpea plants as affected by the presence of AMF at various stages of its growth

Growth Parameters	Treatment	Days		
		30	60	90
Plant height (cm)	T0	25.5±0.01	43.9±1.33	53.5±0.63
	T1	29.5±0.01	50.86±1.43	62.40±1.67
	T2	30.4±0.02	52.41±1.24	64.30±1.75
	T3	30.0±0.03	51.72±1.12	63.46±1.25
Plant width(cm)	T0	1.0±0.04	1.18±0.15	2.02±0.06
	T1	1.31±0.03	1.53±0.09	2.72±0.06
	T2	1.3±0.01	1.54±0.25	2.71±0.54
	T3	1.2±0.02	1.42±1.2	2.50±0.45
Root length (cm)	T0	10.7±0.03	13.31±0.42	14.31±0.63
	T1	13±0.02	16.17±0.45	17.38±0.25
	T2	11.4±0.02	14.18±2.10	15.24±2.1
	T3	12.2±0.01	15.18±1.25	16.32±1.21
Number of leaves per plant	T0	5.0±0.14	6.0±0.25	9.0±0.25
	T1	6.0±0.25	7.0±0.15	12.0±1.25
	T2	6.0±0.50	7.0±0.25	15.0±0.11
	T3	7.0±0.25	8.0±0.11	18.0±0.25
Number of flowers per plant	T0	0.00	4±1.25	00
	T1	00	5±0.97	00
	T2	00	5±1.25	00
	T3	00	6±1.11	00
Number of pods per plant	T0	00	00	2±0.11
	T1	00	00	3±1.05
	T2	00	00	3±1.10
	T3	00	00	4±0.25

Results were found significant at P<0.05following Newman-Keuls Multiple comparison test for one way ANOVA: T= Treatment; T0= Control; T1= *Glomus hoi*; T2= *Acaulospora kinentensis*; T3= *Glomus hoi* + *Acaulospora kinentensis*

Table 3 : Chlorophyll content in Cowpea with and without the presence of AMF at various growth stages

Chlorophyll Contents (mg g-1)	Treatment	Days		
		30	60	90
Chlorophyll-a	T0	0.6±0.01	0.8±0.01	1.2±0.11
	T1	0.6±0.01	0.9±0.02	1.4±0.12
	T2	0.7±0.01	0.95±0.01	1.6±0.11
	T3	0.75±0.02	0.95±0.02	1.7±0.12
Chlorophyll-b	T0	0.9±0.01	1.12±0.01	1.4±0.11
	T1	0.92±0.02	1.13±0.02	1.6±0.12
	T2	0.95±0.01	1.35±0.01	1.65±0.11
	T3	0.99±0.01	1.46±0.02	1.8±0.12
Total chlorophyll	T0	1.51±0.01	1.93±0.01	2.65±0.21
	T1	1.55±0.01	2.03±0.03	3.1±0.11
	T2	1.66±0.02	2.31±0.02	3.3±0.13
	T3	1.71±0.02	2.41±0.01	3.65±0.25

Results were found significant at P<0.05following Newman-Keuls Multiple comparison test for one way ANOVA: T= Treatment; T0= Control; T1= *Glomus hoi*; T2= *Acaulospora kinentensis*; T3= *Glomus hoi* + *Acaulospora kinentensis*

Table 4: Fresh and dry weight of cowpea plants with and without the presence of AMF at various growth stages

Fresh and dry weight (g)	Treatment	Days		
		30	60	90
Root(fresh wt.)	T0	0.1±0.01	0.13±0.01	0.18±0.01
	T1	0.14±0.02	0.16±0.02	0.2±0.04
	T2	0.49±0.02	0.61±0.02	0.73±0.03
	T3	0.26±0.03	0.38±0.03	0.44±0.01
Shoot (fresh wt.)	T0	1.2±0.01	1.5±0.02	1.8±0.01
	T1	1.3±0.04	1.6±0.04	1.9±0.05
	T2	2.25±0.03	2.80±0.01	3.27±0.03
	T3	2.91±0.01	3.51±0.04	4.24±0.04
Total (fresh wt.)	T0	1.33±0.12	1.65±0.03	1.93±0.02
	T1	1.46±0.12	1.92±0.08	2.19±0.05
	T2	2.74±0.13	3.42±0.03	3.99±0.02
	T3	3.17±0.14	4.02±0.25	4.79±0.03
Root (dry wt.)	T0	0.086±0.02	0.091±0.02	0.11±0.01
	T1	0.088±0.01	0.11±0.01	0.16±0.04
	T2	0.089±0.02	0.10±0.01	0.13±0.03
	T3	0.092±0.03	0.11±0.03	0.15±0.01
Shoot (dry wt.)	T0	0.338±0.03	0.45±0.02	0.53±0.01
	T1	0.357±0.03	0.48±0.06	0.60±0.03
	T2	0.354±0.03	0.44±0.01	0.56±0.03
	T3	0.651±0.12	0.82±0.05	0.97±0.04
Total (dry wt.)	T0	0.425±0.03	0.52±0.04	0.61±0.01
	T1	0.445±0.08	0.54±0.02	0.64±0.03
	T2	0.632±0.05	0.78±0.01	0.90±0.03
	T3	0.743±0.08	0.89±0.02	1.04±0.05

Results were found significant at P<0.05following Newman-Keuls Multiple comparison test for one way ANOVA: T= Treatment; T0= Control; T1= *Glomus hoi*; T2= *Acaulospora kinentensis*; T3= *Glomus hoi* + *Acaulospora kinentensis*

Table 5: Fresh weight content of reducing sugar fractions of cowpea plants as affected with and without the presence of AMF during at various growth stages

Reducing Sugars (mg.g-1 fresh weight)	Treatment	Days		
		30	60	90
Reducing sugar content in root fresh weight	T0	2.1±0.12	24.61±1.50	43±1.05
	T1	2.9±0.26	26.50±0.23	40.95±0.73
	T2	3.2±0.21	26.50±0.59	41.50±0.85
	T3	3.2±0.13	27.65±0.81	42.25±1.14
Reducing sugar content in soot fresh weight	T0	3.5±0.13	30.06±0.41	55.47±0.27
	T1	4.69±0.37	32.47±0.94	58.63±1.80
	T2	5.19±0.14	33.64±0.48	58.69±0.93
	T3	5.13±0.14	33.95±1.32	59.95±0.62

Results were found significant at P<0.05following Newman-Keuls Multiple comparison test for one way ANOVA: T= Treatment; T0= Control; T1= *Glomus hoi*; T2= *Acaulospora kinentensis*; T3= *Glomus hoi* + *Acaulospora kinentensis*

Table 6: Fresh weight content of non-reducing sugar fractions of cowpea plants as affected with and without the presence of AMF during at various growth stages

Non reducing Sugars (mg.gm-1 fresh weight)	Treatment	Days		
		30	60	90
Non reducing sugar content in root fresh weight	T0	98.9±1.19	133.3±0.71	141±1.43
	T1	101.1±1.70	142.5±1.40	149.05±1.41
	T2	102.8±1.14	146.5±0.71	150.5±1.50
	T3	102.8±0.65	147.35±1.32	152±1.17
Non reducing sugar content in soot fresh weight	T0	116.29±0.93	145.94±0.72	166.53±0.59
	T1	174.27±1.01	182.53±1.15	187.73±1.30
	T2	184.13±0.75	187.36±1.75	189.31±0.11
	T3	187.83±1.90	191.05±1.98	189.05±1.09

Results were found significant at P<0.05following Newman-Keuls Multiple comparison test for one way ANOVA: T= Treatment; T0= Control; T1= *Glomus hoi*; T2= *Acaulospora kinentensis*; T3= *Glomus hoi* + *Acaulospora kinentensis*

Table 7: Fresh weight content of total sugar fractions of cowpea plants as affected with and without the presence of AMF during at various growth stages

Total Sugars (mg.gm-1 fresh weight)	Treatment	Days		
		30	60	90
Total sugar content in root fresh weight	T0	101±1.05	158±0.85	184±1.24
	T1	104±1.50	169±1.21	189±1.14
	T2	106±1.10	173±0.68	191±1.25
	T3	106±0.76	175±1.23	194±1.25
Total sugar content in soot fresh weight	T0	119.79±5.14	176±1.25	222±1.95
	T1	178.96±7.68	215±1.72	246±1.75
	T2	189.29±6.58	221±1.85	248±1.78
	T3	192.96±6.48	225±2.25	249±1.25

Results were found significant at P<0.05following Newman-Keuls Multiple comparison test for one way ANOVA: T= Treatment; T0= Control; T1= *Glomus hoi*; T2= *Acaulospora kinentensis*; T3= *Glomus hoi* + *Acaulospora kinentensis*

Table 8: Fresh weight content of protein fractions of cowpea plants as affected with and without the presence of AMF during at various growth stages

Total protein (mg.g-1 fresh weight)	Treatment	Days		
		30	60	90
Root	T0	22±1.02	38±1.30	48±1.30
	T1	41±0.42	51±0.60	56±0.25
	T2	43±0.43	56±0.51	63±1.34
	T3	45±0.33	58±0.82	65±0.83
Shoot	T0	37.39±0.12	51±0.27	61±0.72
	T1	57.23±0.32	64±0.52	71±0.92
	T2	59.33±0.23	69±0.27	74±0.47
	T3	61.43±0.33	71±1.25	74±1.21

Results were found significant at P<0.05following Newman-Keuls Multiple comparison test for one way ANOVA: T= Treatment; T0= Control; T1= *Glomus hoi*; T2= *Acaulospora kinentensis*; T3= *Glomus hoi* + *Acaulospora kinentensis*

Table 9: Fresh weight content of phenol content of cowpea plants as affected with and without the presence of AMF during at various growth stages

Total phenol (mg.g-1 fresh weight)	Treatment	Days		
		30	60	90
Total phenol content in root	T0	6.8±0.19	14±0.41	19±0.52
	T1	12.3±0.24	16.5±0.31	23±0.62
	T2	14±0.62	19.3±0.71	25.6±0.65
	T3	16±0.48	19.8±0.73	26.3±0.55
Total phenol content in shoot	T0	21.73±0.94	37±0.47	43±0.27
	T1	27±0.85	41±0.37	49±0.45
	T2	33±0.47	44±0.98	51±0.54
	T3	37±1.41	44±0.68	52±0.95

Results were found significant at P<0.05following Newman-Keuls Multiple comparison test for one way ANOVA: T= Treatment; T0= Control; T1= *Glomus hoi*; T2= *Acaulospora kinentensis*; T3= *Glomus hoi* + *Acaulospora kinentensis*

Fig 1: Cowpea plants

Fig 2: Pot experiment setup of cowpea plant

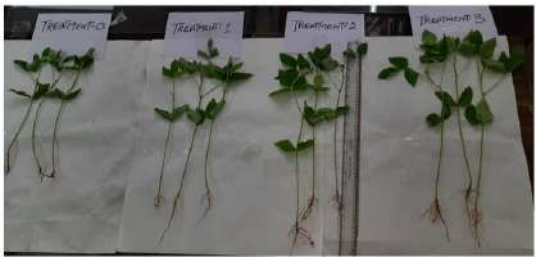

Fig 3: Cowpea plants after harvesting

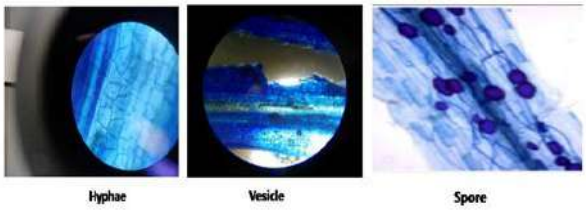

Fig 4: Different structures of root colonization of AM fungi treated cowpea plants

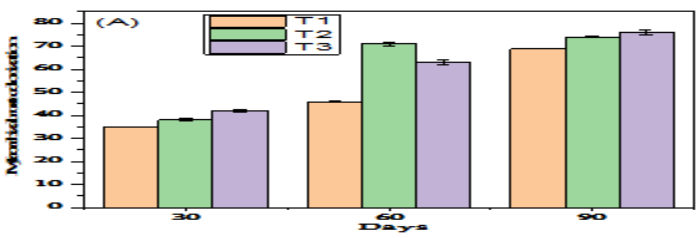

Fig 5: Percentage root colonization of cowpea plants grown under pot trials

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RESEARCH ARTICLE

Extraction and Preliminary Screening of Fructosyltransferase Enzyme from *Streptococcus mutans* of Clinical Dental Caries Sample

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ABSTRACT

The aim of our present study is to extract the fructosyltransferase enzyme (FTF) from *Streptococcus mutans,* the presence of fructosyltransferase enzyme which helps in the pathogenesis of dental caries serves as extracellular carbohydrate storage compounds that can be metabolized by bacteria during periods of nutrient deprivation, *S.mutans*is one of the primary etiological agents for dental caries formation, in our preliminary studies 60 clinical isolates were isolated , out of which 36 were found to be positive for *Streptococcus mutans,* and out of thirty six, thirty found to be positive for fructosyltransferase enzyme production, and enzymes were preliminary screened, and partially purified using dialysis membrane, and the isolates SM-18 showed the highest activity of enzyme and protein concentration and hence selected for further analysis. The optimization studies of enzyme showed that the optimum enzyme concentration was reported highest at pH- 6.0-6.9, Temperature at 38°C, and incubation time was at 18-19 hrs. and extracted enzyme showed Precipitation at 60-70% by ammonium sulphate precipitation method. and molecular weight of around ~ 63 kDa.

Keywords: Dental caries, *Streptococcus mutans,* Glucosyltransferase, fructosyltransferase, enzyme screening.

INTRODUCTION

The ability of *Streptococcus mutans* to produce extracellular enzyme from carbohydrate is the key factor that supports the development of dental caries [1,2].*Streptococcus mutans* produces three different glucosyltransferases (GTFs) that are responsible for the synthesis of various glucan polymers and GTFs from *S. mutans* synthesize a mixture of α (1→3)- linked insoluble glucans [3]. *S. mutans* also produces fructosyltransferase (FTF)[4], which synthesizes fructans polymers from sucrose[5,6], and α(1→6)-linked soluble glucans, whereas FTF produces α(2→6)- linked fructans. Fructans may influence the pathogenesis of dental caries serving as extracellular carbohydrate storage compounds, that can be metabolized by bacteria during periods of nutrient deprivation [7,8].*S. mutans* uses the enzyme glucan sucrose to convert sucrose into a sticky, extracellular, dextran-based polysaccharide that allows them to cohere, forming plaque. *S. mutans* produces dextran via the enzyme dextransucrase using sucrose as substrate in the following reaction:*n* sucrose → $(\text{glucose})_n$ + *n* fructose, However, other sugars: glucose, fructose, lactose can also be digested by *S. mutans,* but they produce lactic acid as an end product. The combination of plaque and acid leads to dental decay [9]. In our present study, fructosyltransferase enzyme were extracted from *S. mutans* and preliminarily screened and partially purified and different parameters of enzyme optimizations were carried out.

MATERIALS AND METHOD

Sample collection

Clinical dental caries sample were collected from Department of Dentistry, District McGann Hospital, Shivamogga, and Giriraj Dental Clinic, Shivamogga, Karnataka, dental caries infected teeth samples were collected and samples were transferred into 2 ml of saline solution (0.4% agar, 0.15% thioglycolate/phosphate buffered saline) and transported to a laboratory and streaked onto blood agar media. The plates were incubated for 24-48 hours at 37°C. colonies Howingα-hemolysis were selected for further biochemical tests. And standard culture of *Streptococcus mutans* (NCIM Accession No: 5660) were procured from NCIMpune in Lyophilized form, for the confirmatory test with our clinical isolates.

Characterization of bacterial isolates

Identification of the isolates was done using standard cultural, morphological, and biochemical characteristics as describedin the Bergey's Manual of Determinative Bacteriology [10], and Murray Manual of clinical microbiology 8th edition [11] and further *Streptococcus mutans* confirmation were performed by following the methodology of Gold *et al.,* [12].

Extraction of Fructosyltransferase Enzyme from *S. mutans*

The clinical isolates were evaluated for extracellular fructosyltransferase enzyme synthesis by following the methodologies of Essam *et al.,* (2009),[13]Beeleyand Black (1977)[14] with necessary modification. Todd-Hewitt (TH) broth (250ml) were supplemented with 1.8% fructose and inoculated with 24 hrs. old bacterial culture and incubated at 37°C for 18-24 hrs., After incubation the broth were centrifuged at 5000 x gat 4°C for 15 Mins. And supernatant were collected and protein concentration were estimated by Lowry's Method. The pH of the supernatant was adjusted to 6.9to this 2.5ml of fructose solution (50%) and 12.5ml of sodium azide (0.02%) were added to the supernatant and incubated at 37°C for 18 hrs., then the supernatant was centrifuged at 5000 x g at 4°C for 30 minutes and to this supernatant, 200 ml of cold absolute ethanol was added and kept at refrigerator for 4 hrs. and again centrifuged at 6000 x g at 4°C for 30 minutes After centrifugation the precipitate obtained (fructans)was dissolved in 5 ml of tris-HCl buffer (0.025M) containing 0.1M NaCl, were stored at refrigerator for further analysis.

Screening of Fructosyltransferaseenzyme

Crude Fructosyltransferase Enzyme were preliminary screened for the quantification of Enzyme and Protein Concentration [15-18].

Estimation of protein

Quantification of protein for the extracted enzyme was carried out by following the methodology of Lowry *et al*, (1951), using bovine serum albumin as the standard.

Enzyme activity

Fructosyltransferase enzyme activity was estimated by following the methodology of Mukasa*et al.,* (1982).

Ammonium sulphate Precipitation

Cell lysis were carried out and the lysed content was used for the protein purification, using ammonium sulphate precipitation technique by following the methodology of Richards (2009).

Dialysis

The enzyme precipitate obtained from ammonium sulphate precipitation was dissolved in 0.01M phosphate buffer (pH 6.9) and were dialyzed against the same buffer 0.01M phosphate buffer for 24-48 hours at 4°C with constant stirring and the buffer was changed frequently at every 1-2 hrs. intervals of time. At each step the enzyme activity and protein concentrations of culture filtrate were estimated

Sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDSPAGE)

Sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDSPAGE) was carried out by following the methodology of Laemmli (1970)using 12% cross linked polyacrylamide gel using a mini slab gel apparatus (Bangalore Genei Pvt. Ltd., India) The crude enzyme preparation was loaded onto the gel, After running the gel they were stained with Coomassie brilliant blue and the molecular weight of the enzyme was determined with reference to molecular weight marker (Broad Range Marker, Merck Life sciences).

Enzyme optimization

The various parameters selected for optimization of fructosyltransferase enzyme includes the following:

Effect of pH on Enzyme activity

FTF's enzyme was estimated by measuring the enzyme activity at various pH ranging from pH 4.5- pH 8.5.

Effect of substrate concentration on Enzyme activity

Effect of substrate concentration on the activity of fructosyltransferase was conducted by incubating 50µl crude FTF's enzymein sodium phosphate buffer (0.01M), pH 6.9 and various concentration of fructose (20,40,60,80, up to 200 g/L) at 37°C for 18hrs.

Effect of Incubation period on Enzyme activity

Effect of incubation time on the activity of fructosyltransferase was carried out by incubating 50ul of crude fructosyltransferase enzyme in sodium phosphate buffer (0.1M) with 150mM fructose at 37°C.The enzyme activity was calculated at different intervals of time from 2 hrs. to 50 hrs. of incubation.

Effect of temperature on Enzyme Activity

50 µl of FTF enzyme was dissolved in 0.01M Sodium phosphate buffer (pH 6.5) and they were incubated at various temperature ranges from 4°C to 60 °C for 18 hrs.

RESULT AND DISCUSSION

Isolation of *Streptococcus mutans* from clinical Dental Caries samples

A total of sixty dental caries samples were collected and of which 36 were found to be positive for *Streptococcus mutans* indicating that *S.mutans* was most predominant strain (60%) in dental caries infection [Fig 1], *Streptococcus*

mutans were identified based on colony morphology, biochemical characterization as described in the Bergey's Manual of Determinative Bacteriology [Table 01].

Screening of Fructosyltransferase Enzyme from *Streptococcus mutans*

The total of thirty-six clinical isolates screened for the production of fructosyltransferase enzyme (FTF) of which twenty-eight clinical isolates were found to produce fructosyltransferase enzyme (Prevalence rate of 77.7%) and among the isolates, SM-18 was found to be good FTF Producer with enzyme activity of 3.30 U mol/ml/min and protein concentration of 601.52 mg/ml [Fig 2 &3], hence selected for further studies.

Ammonium sulphate precipitation

The protein were precipitated at different concentration using ammonium sulphate precipitation technique and results were tabulated[Table 2], at concentration of 60-70% maximum Precipitation was observed and the precipitated protein was partially purified using dialysis membrane.

Sodium dodecyl sulphate polyacrylamide gel electrophoresis SDSPAGE

Different concentration of ammonium sulphate precipitations was analyzed and were subjected to 12% SDSPAGE, from Lane one to Lane 6, fructosyltransferase enzyme was prominent. [Fig 4] and partially purified enzyme obtained from dialysis membrane were also loaded into 12% SDSPAGE and the molecular weight was found to be ~63K Da. [Fig 5].

Enzyme optimizations

The various parameters of optimization of fructosyltransferase enzyme were analyzed and the optimum pH for the FTF enzyme was found to be 6.6-6.9, the ideal substrate concentration was 60g/ Land the optimum incubation time was found to be 18-19 hrs. and enzyme showed highest activity at 38^{o} C.

DISCUSSION

In this study *Streptococcus mutans* showed advantages for its production of fructosyltransferase enzyme. compared to the results reported in the literature, biochemical characterization of the enzyme is essential to select the best parameters to obtain highest yield therefore fructosyltransferase were extracted and screened. Preliminary studies of the fructosyltransferase enzymes provide information about the diverse range of reactions and their role in dental caries formation which help us to inhibit the enzyme which causes dental caries using different kind of inhibitors. *S.mutans*, a member of the viridians streptococci, is considered to be primarily responsible for dental caries, which is the most common oral diseases. In our study, *S. mutans* isolates were identified based on microscopic examination showing gram-positive cocci that are arranged in long chains. In addition, the isolates were able to produce alpha hemolysis on blood agar media as previously confirmed for *S. mutans* [20]. Based on biochemical testing, *S. mutans* isolates were catalase-negative, able to ferment the sugars like mannitol, sorbitol, and sucrose and to change the color of phenol red indicator from red to yellow due to acid production from carbohydrate fermentation similar results were observed by Al-Jumaily *et al.,* and Vos *et al.,*[21,22]. Several species of oral bacteria known to synthesize fructans which includes *S. mutans, Streptococcus salivarius, Streptococcus sanguis*, and the actinomyces sp. [23-26]. In our present study fructosyltransferase enzyme has been extracted from *Streptococcus mutans.* and were preliminarily screened and were partially purified, in contrast with another study by Qiong Zhang (2021) in which Glucosyltransferase enzyme [27] were extracted which is an another major enzymes which is responsible for the caries formation. The extracted fructosyltransferase enzyme showed highest enzyme activity of 3.30 Umol/ml/min and molecular weight of our enzyme found to be ~63K Da [Fig 4&5]. in another study by Han *et al*.., (2020)[28]. Showed extracellular fructosyltransferase enzyme from *Aspergillus* sp. in which their molecular weight was found to be around 50.0 – 90.0 kDa. In our enzyme optimization studies enzyme showed highest enzyme activity at pH of 6.6-6.9 and Temperature 38^{o}C, and substrate concentration of 60g/L, incubation time of 18-19 hrs these were most optimum parameters for the highest enzyme activity reported in our present study and similarly another work

carries out by Han *et al*.., (2020) indicated that the enzyme exhibits different dissociation states under different pH conditions, and FTase was also found to be stable at 40 °C for up to 4h, and which agrees with the results of Yang *et al.* (2016) [29], According to Choukade and Kango (2019)[30]regarding sucrose concentration it was reported that at concentrations exceeding 5%, the rate of hydrolysis gradually decreased. Further purification and inhibition of fructosyltransferase enzyme are in progress.

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Table 1: Biochemical characterization of *S. mutans* isolates.

Test	Results
Gram stain	Gram positive
Shape	Cocci in long chains
Motility	Non -Motile
Catalase	Negative
Hemolysis	α and β
Esculin hydrolysis	Positive
Arginine hydrolysis	Negative
Urea hydrolysis	Negative
Voges-Proskauer test	Positive
Optochin sensitivity	Negative
Growth on 6.5% NaCl	Negative

Table 2: Quantification of fructosyltransferase enzyme at different concentration of Ammonium Sulphate Precipitation.

Sample	OD @550	Concentration of the sample (mg /ml)
control	0.021	-106.00
20%	0.48	1424.00
30%	0.53	1590.67

40%	0.69	2124.00
50%	0.89	2790.67
60%	1.185	3774.00
70%	1.68	5424.00

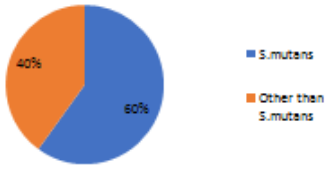

Fig. 1. Prevalence Rate of S. mutansfrom Dental caries

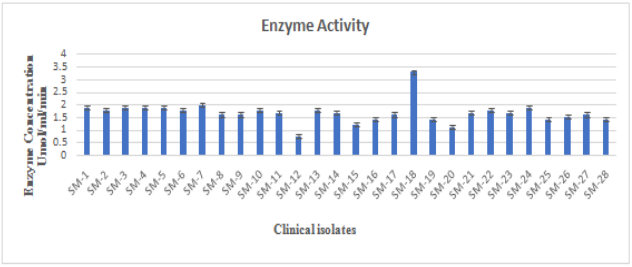

Fig. 2. Enzyme activity of the clinical isolates.

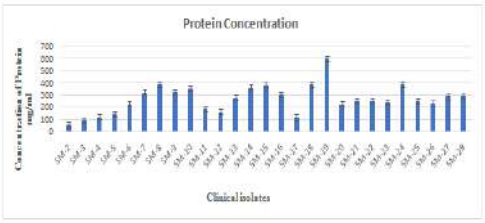

Fig 3: Protein Concentration of the clinical isolates.

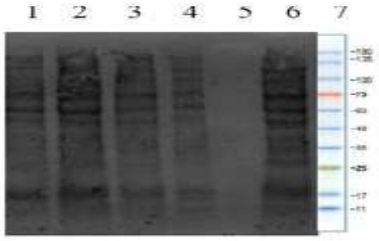

Fig 4: Lane 1: 20% ammonium sulphate, lane 2: 30% ammonium sulphate, lane 3: 40% ammonium sulphate, Lane 4: 50% ammonium sulphate, lane 5: blank well, lane, lane 6: 60 % ammonium sulphate 7: Ladder

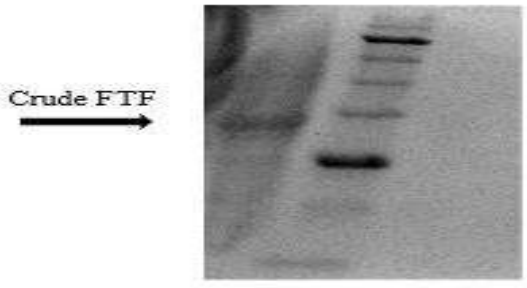

Fig. 5. Lane 1: 48 hr Dialysis, lane 2: Ladder

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RESEARCH ARTICLE

Impact of Inorganic and Organic Sources of Nutrients on Growth Parameters of Ragi in Ragi-Horsegram Sequence

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ABSTRACT

The field experiment was conducted during June,2021 at Valiyampattu Village, Sankarapuram Taluk, Kallakurichi District, Tamil Nadu to find out the effect of different levels of inorganic fertilizers with different composts on growth parameters in ragi (*Elusine coracana* L. Gaertn). The experiment consist of twelve treatments which was replicated thrice. The design of the experiment was randomized block design (RBD). The twelve treatments included in the study were T_1 - Absolute Control, T_2 - 100% RDF ($N;P_2O_5:K_2O$) (60:30:30 kg ha^{-1}), T_3 - 75% RN(C.F) + 25% RN(GLMC), T_4 - 75% RN(C.F) + 25% RN (GOC), T_5 - 75% RN(C.F) + 25% RN (PMC), T_6 - 75% RN(C.F) +25% RN(CPC), T_7 - 50 % RN(C.F) + 25% RN (GLMC) + 25% RN(GOC) , T_8 - 50 % RN(C.F) + 25% RN(PMC) + 25% RN(CPC), T_9 - 50 % RN(C.F) + 25% RN(GLMC) + 25% RN(PMC), T_{10} - 50 % RN(C.F) + 25% RN(GLMC) + 25% CPC, T_{11} - 50% RN(C.F) + 25% RN(GOC) + 25% RN(PMC) and T_{12} - 50% RN(C.F) + 25%RN (GOC) + 25% RN(CPC). The results of present study revealed that combined application of 50 % RN through chemical fertilizer + 25% RN through GLMC + 25% RN through GOC (T_7) recorded significantly highest growth parameters *viz.,* plant height, number of leaves $plant^{-1}$, number of tillers $plant^{-1}$, leaf area index and dry matter production at 30 DAT , 60 DAT and at harvest in ragi.

Keywords: Ragi, inorganic fertilizers, green leaf manure compost, groundnut oil cake, press Mud compost, coir pith compost and growth parameters

INTRODUCTION

Millets have been recognized super cereals by virtue of their climate resilence and superior nutritional profile. Finger millet (*Elusine coracana*) (L.) Gaertn), the domesticated coarse cereals of African origin form stable food for the people in the drier parts of India, Africa and some of the other Asian countries. Being a minor millet, ragi cultivation is traditionally rain fed and confined to marginal soils, resulting large yield gaps. Optimization of nutrient managment with emphasis on organics will help in attaining and sustaining higher yields (Rabeen Abdul Gafoor *et al.,* 2021). It is often referred to as 'poor man's crop' or as 'famine food'. The total millet area in the world, 12 per cent is finger millet, spread over more than 25 countries in Africa and Asia accounting for 10 per cent of the total millet production (Kumar *et al*., 2016). It contains 9.2% protein, 1.29% fat, 76.32% carbohydrate, 2.24% minerals and 3.9% ash besides vitamin A and B. In India, it is grown in an area of 1.19 million hectares with the production of 1.98 million tonnes and the productivity is 1661 kg ha^{-1} (Raghuvaran *et al*., 2021). The major ragi growing states in India are Karnataka, Tamil Nadu, Andhra Pradesh, Orissa, Jharkhand, Maharashtra and Uttaranchal. In Tamil Nadu, ragi is grown with an area of 0.61 lakh hectares resulting in production of 0.11 million tonnes with the productivity of 1966 kg ha^{-1} thatprovides food and nutritional security to the marginal farmers in the rainfed dry lands and hilly tribal areas (India Stat, 2017). Pongamia pinnata is one of the few nitrogen fixing trees and it can be used to enrich soil. Incorporation of leaves improves soil fertility and favourable effect on growth and yield of many crops (Savitha *et al*., 2010). Oilcakes helps in the improvement of soil structure, aeration and water holding capacity of soil. Further, it stimulates the activity of microorganisms that makes the plant to get the macro and micro-nutrients through enhanced biological processes, increase nutrient solubility, alter soil salinity, sodicity and pH. (Alabadan *et al*., 2009). Pressmud compost helps to increase soil fertility and enhance crop production because it is rich in appreciable amount of essential plant nutrients *viz*., organic carbon, nitrogen, phosphorus, potassium, calcium and magnesium along with traces of micronutrients *viz*., Zn, Fe, Cu and Mn (Banulekha, 2007). Coir pith is an agro-waste produced during coir fibre extraction, constituting about 70% of coconut husk (Pazhanivel *et al.,* 2011). Coir pith compost have various beneficial characteristics and it is productive resource for use in agriculture. The main objectives of IPNS are improvements in crop performance and resource use efficiency while minimizing negative environmental impacts (Thilakarathna and Raizada, 2015).

MATERIALS AND METHODS

The present investigation was carried out during June, 2021 at the Farmers Field, ValiyampattuVillage, Sankarapuram Taluk, Kallakurichi District, Tamil Nadu, India.The experiments were laid out in RBD (Randomized Block Design), Ragi (*Elusine coracana* L. Gaertn), CO - 14 grwon as a test crop. The experimental soil was sandy loam in texture with a pH of 7.63. The experiment consist of twelve treatments which was replicated thrice. The twelve treatments were T_1 - Absolute Control, T_2 - 100% RDF ($N;P_2O_5:K_2O$) (60:30:30 kg ha^{-1}), T_3 - 75% RN(C.F) + 25% RN(GLMC), T_4 - 75% RN(C.F) + 25% RN (GOC), T_5 - 75% RN(C.F) + 25% RN (PMC), T_6 - 75% RN(C.F) +25% RN(CPC), T_7 - 50 % RN(C.F) + 25% RN (GLMC) + 25% RN(GOC) , T_8 - 50 % RN(C.F) + 25% RN(PMC) + 25% RN(CPC), T_9 - 50 % RN(C.F) + 25% RN(GLMC) + 25% RN(PMC), T_{10} - 50 % RN(C.F) + 25% RN(GLMC) + 25% RN(CPC), T_{11} - 50% RN(C.F) + 25% RN(GOC) + 25% RN(PMC) and T_{12} - 50% RN(C.F) + 25%RN (GOC) + 25% RN(CPC). The recommended dose of fertilizers ($N:P_2O_5:K_2O$) (60:30:30 kg ha^{-1}) were applied to the field through Urea, SSP and MOP, respectively. Nitrogen was applied in two splits at 20 and 40 DAS. The full dose of P_2O_5 and K_2O were given as basal by band placement method. The different composts *viz*., green lean manure compost(GLMC), pressmud compost (PMC) and coir pith compost (CPC) and groundnut oil cake were applied as per the N equivalent to the respective plot. The ragi cv. CO 14 was grown with recommended cultural practices. The growth parameters of ragi cv.CO 14 due to different treatments were studied and incorporated.

RESULT AND DISCUSSION

Plant height (cm)

The data on plant height (cm) and number of leaves plant^{-1} of ragi cv.CO 14 as influenced by different levels of inorganic fertilizers, different composts at different growth stages are presented in table 1. There was a significant difference observed between the treatments.

30 DAT

The highest plant height of 54.7 cm was observed with 50 % RN (C.F) + 25% GMC + 25% GOC(T_7). Which was followed by application of 50% RN(C.F) + 25% GOC + 25% PMC (T_{11}) registered plant height of 52.3 cm and 100% RDF (60:30:30) (T_2) recorded plant height of 51.8 cm. The treatment T_{11} on par with T_2. The tretments T_3, T_4 and T_5 registered plant height of 38.7, 49.2 and 45.1 cm which were received 75% RN (C.F) + 25% RN(GMC), 75% RN(C.F) + 25% RN(GOC) and 75% RN (C.F) + 25% RN(PMC), respectively. However lowest plant height of 30.6 cm was noticed in control (T_1).

60 DAT

Application of different levels of inorganic fertilizers and different composts signficantly increased plant height at 60 DAT ranged from 49.9 to 82.4 cm. Application of 50 % RN (C.F) + 25% GMC + 25% GOC(T_7) registered highest plant height (82.4 cm). Application of 50% RN(C.F) + 25% GOC + 25% PMC (T_{11}) and 100% RDF (T_2) registered plant height of 78.3 and 77.6 cm, respectively. These treatments were on par with each other. Application of 50 % RN(C.F) + 25% PMC + 25% CPC(T_8), 50 % RN (C.F) + 25% GMC + 25% PMC (T_9) and 50 % RN(C.F) + 25% GMC+ 25% CPC(T10) recorded plant height of 62.6,71.1 and 70.6 cm, respectively. The treatment T_9 was on par with T_{10}. However, lowest plant height was found to be with control (T_1)(49.9cm).

At harvest

Significantly highest plant height of 113.4 cm was observed in T_7 which was received 50 % RN (C.F) + 25% GMC + 25% GOC. Which was followed by 109.3 and 108.5 cm were found to be with 50% RN(C.F) + 25% GOC + 25% PMC (T_{11}) and 100% RDF (T_2), respectively. Application of 75% RN(C.F) + 25% RN(GMC)(T_3), 75% RN(CF) + 25% RN(GOC)(T_4), 75%RN(C.F) + 25% RN(PMC) (T_5) and 75%RN C.F)+25% RN(CPC)(T_6) registered plant height of 85.2, 104.1, 94.0 and 81.1 cm, respectively. However, control (T_1) treatment recorded the lowest plant height of 76.7 cm. This might be due to groundnut oilcake and NPK fertilizers have the tendency of supplying nutrients to plants throughout the cropping season thereby improving the plant height of crops. Yakubu *et al*., (2014). Groundnut oilcake performed well during the growing season mainly because decomposition of soil organic matter is a slow release source of nutrients to plants and a source of carbon to micro-organisms (Guertal, 2000). This might be also due to consistent supply of nutrient to finger millet by the decomposed green leaf manures of pongamia pinnata, which might have released the nutrient present in the leaves resulting in increased cell division and cell elongation, there by increased the plant height (Tripathi *et al*. 2000). Further, the conjunctive use of organic and inorganic sources improved soil properties and prolonged the availability of nutrients throughout crop growth period reflecting in better plant height. Giribabu *et al*. (2010), Pallavi *et al*. (2014) and Prakasha *et al*. (2017)

Number of leaves plant^{-1}

The number of leaves plant^{-1} exhibited significant difference due to application of different levels of iorganic fertilizers in combinations with different composts at different growth stages of ragi are furnished in table 1.

30 DAT

The highest number of leaves was recorded with 50 % RN (C.F) + 25% GMC + 25% GOC (T_7) (7.29). Which was followed by application of 50% RN(C.F) + 25% GOC + 25% PMC (T_{11}) and 100% RDF (60:30:30) (T_2) recorded number of leaves plant^{-1} of 7.02 and 6.96, respectively. The treatment T_{11} on par with T_2. The tretments T_3, T_4 and T_5 registered number of leaves plant^{-1} of 5.77, 6.73 and 6.38 which were received 75% RN (C.F) + 25% RN(GMC), 75% RN(C.F) +

25% RN(GOC) and 75% RN (C.F) + 25% RN(PMC), respectively. However lowest number of leaves plant^{-1} was registered under control (T_1)(5.14).

60 DAT

A significant increase in the number of leaves plant $^{-1}$ was observed with the application of 50 % RN (C.F) + 25% GMC + 25% GOC (T_7) (9.85). Application of 50 % RN(C.F) + 25% PMC + 25% CPC(T_8), 50 % RN (C.F) + 25% GMC + 25% PMC (T_9) and 50 % RN(C.F) + 25% GMC+ 25% CPC(T_{10}) recorded number of leaves plant^{-1} were 7.76, 8.69 and 8.60, respectively. The treatment T_9 was on par with T_{10}. However, lowest number of leaves plant^{-1} was registered in control (T_1)(6.54).

At harvest

Among the different treatments tried, application of 50 % RN (C.F) + 25% GMC + 25% GOC (T_7) registered highest number of leaves plant^{-1}(10.62) against control (8.20). Application of 100% RDF (T_2), 75% RN(C.F) + 25% RN(GMC)(T_3), 75% RN(CF) + 25% RN(GOC) (T_4), 75%RN(C.F) + 25% RN(PMC) (T_5) and 75%RN C.F)+25% RN(CPC) (T_6) recorded the number of leaves plant $^{-1}$ of 10.32, 9.06, 10.04,9.64 and 8.74, respectively. However, lowest number of leaves plant^{-1} was observed in control (T_1) (8.20). Soil application of macro nutrients might have favoured better absorption of nutrients resulted in increased number of leaves plant^{-1}. Similar results have been reported by Sudhakar, (2000). The results also due to soil application of NPK significantly increased number of leaves plant^{-1} might have great supply of nutrients with efficient utilization for cell multiplication and cell enlargement and formation of nucleic acids and other vitally important organic compounds in the cell sap. This clearly indicated that less competition for nutrient and other resources and higher rate of photosynthetic efficiency. A similar result was reported by Kumar *et al*. (2015) in pear millet.

Number of tillers plant^{-1}

The number of tillers plant^{-1} at 30 DAT, 60 DAT and at harvest ranged between 1.71 and 3.84, 3.25 and 6.11 and 3.76 and 7.81, respectively due to different levels of inorganic fertilizers in combinations with different composts.

30 DAT

Application of 50 % RN (C.F) + 25% N(GMC) + 25%N (GOC) (T_7) was superior in increasing number of tillers plant^{-1} (3.84) than other treatments. The next best number of tiller plant^{-1}(3.59) was oberved in T_{11} which was received 50% RN(C.F) + 25% N (GOC) + 25% N(PMC). The tratments T_2, T_3, T_4, T_5 and T_6 registered number of tillers plant^{-1} of 3.54, 2.42, 3.32, 2.91 and 2.08, respectively. The treatments T_{11} was on par with T_2. However, lowest number of tillers plant^{-1} found to be with control (T_1)(1.71).

60 DAT

The highest number of tillers plant^{-1} (6.11) was observed in the treatment 50 % RN (C.F) + 25% N(GMC) + 25%N (GOC) (T_7), which was followed by the treatment 50% RN(C.F) + 25% N (GOC) + 25% N(PMC) (T_{11}) (5.75) and 100%RDF (T_2) (5.71). The treatment T_{11} on par with T_2. Similarly the treatment T_9 and T_{10} registered number of tillers plant^{-1} of 5.06 and 5.00 were on par with each other. However, lowest number of tillers plant^{-1} was registered in control (T_1)(3.25).

At harvest

The plot received 50 % RN (C.F) + 25% N(GMC) + 25%N (GOC) (T_7) registered highest number of tillers plant^{-1}(7.81). which was followed by % RN(C.F) + 25% N (GOC) + 25% N(PMC) (T_{11}) and 100%RDF (T_2) registered number of tillers plant^{-1} of 7.32 and 7.26, respectively. Application of T_3, T_4, T_5 and T_6 registered number of tillers plant^{-1} of 5.07, 6.85, 6.20 and 4.56, respectively. However, lowest number of tillers plant^{-1} at harvest stage was 3.76 found to be with control (T_1). This might be due to organic wastes enhanced plant growth favourably due to supply of nutrients from pressmud (Rai *et al.* (2004). This might be also due to greater supply of N from organic and inorganic sources with efficient utilization for cell multiplication and enlargement and formation of nucleic acids and other vitally

important organic compounds in cell sap, which in turn enhanced number of tillers plant^{-1} . This concurs with the report of Basavaraj Naik *et al.* (2017).

Leaf area index

The data on leaf area index significantly differed due to different treatments at different growth stages of ragi are presented in table 2.

30 DAT

Significantly highest leaf area index of 2.15 was noticed in T_7 which was received 50 % RN (C.F) + 25% N (GMC)+ 25% N(GOC). Application of 50% RN(C.F) + 25% N(GOC) + 25%N (PMC) (T_{11}) and 100% RDF (T_2) recorded leaf area index of 2.11 and 2.09, respectively. The treatment T_{11} was on par with T_2. The treatments T_3, T_4, T_5 and T_6 registered leaf area index of 1.88, 2.05, 1.99 and 1.82, respectively. However, lowest leaf area index of 1.76 was noticed in control (T_1).

60 DAT

Leaf area index at 60 DAT was found to be highest in the treatment T_7 which was received 50 % RN (C.F) + 25% N (GMC) + 25% N(GOC) (2.20). which was followed by 3.90 and 3.82 were found to be with 50% RN(C.F) + 25% N(GOC) + 25%N (PMC) (T_{11}) and 100% RDF (T_2), respectively. The treatment T_{11} was on par with T_2. Application of 50 % RN + 25% N (GMC) + 25% N(PMC) (T_9) and 50 % RN + 25% N(GMC)+ 25% N(CPC) (T_{10}) registered leaf area index of 3.33 and 3.26, respectively. The treatment T_9 was on par with T_{10}. However, lowest leaf area index at 60 DAT was 2.20 found to be with control (T_1).

At harvest

Similar above trend was observed at harvest stage of ragi for leaf area index due different treatments. Significantly highest leaf area index (3.05) was obtained with T_7 - 50 % RN (C.F) + 25% N (GMC) + 25% N(GOC). Application of 50% RN(C.F) + 25% N(GOC) + 25%N (PMC) (T_{11}) and 100% RDF (T_2) recorded leaf area index of 3.05 and 3.01, respectively. The treatments 50 % RN + 25% N(GMC) + 25% N(PMC) (T_9) and 50 % RN + 25% N(GMC)+ 25% N(CPC)(T_{10}) registered leag area index of 2.71 and 2.66, respectively. The treatment T_9 was on par with T_{10}. However, lowest leaf area index of 1.84 was recorded in control (T_1). This might be due to fertilizer application in particular nitrogen helps maintenance of higher number of leaf, leaf area and leaf area index. The results are in conformity with the finding of Reddy (1999). The increase in leaf area index maight be due to application of green leaf manure compost and inorganic fertilizers had higher available nitrogen and organic carbon content that caused increase in leaf size which ultimately resulted in higher leaf area index. The results were in agreement with the findings of Giribabu (2006) and Prasad *et al.,* (2010). This was also might be due to owing to greater cell division and cell enlargement with higher nitrogen availability leading to vigorous vegetative growth. These are in conformity with the findings of Jat *et al*. (1994). Synthesis of higher amount of photo synthate by finger millet at all stages increased leaf area index. Similar results were also observed by Deshmukh (2007)

Dry matter production (kg ha^{-1})

The data on dry matter production of ragi as influenced by different levels of inorganic fertilizers and differnt composts are given in table 3. The effect of treatments on dry matter production was statiscally significant.

30 DAT

Application of 50 % RN (C.F) + 25% N (GMC) + 25% N(GOC)(T_7) recorded the highest dry matter production of 2912.3 kg ha^{-1} . which was followed by Application of 50% RN(C.F) + 25% N(GOC) + 25%N (PMC) (T_{11}) and 100% RDF (T_2) registered dry matte production of 2781.2 kg ha^{-1} and 2714.7 kg ha^{-1}, respectively. Application of T_3, T_4 and T_5 recorded the dry matter production of 2026.8, 2576.1 and 2321.8 kg ha^{-1}, which were received 75% RN + 25% N(GMC), 75% RN + 25% RN(GOC) and 75%RN + 25% RN(PMC), respectively. However, lowest dry matter production of 1802.5 was found to be with control (T_1).

60 DAT

The dry matter production at 60 DAT ranged from 2876.3 to 4825.3 kgha^{-1} due to different levels of inorganic fertilizers and different compost. There was a significant difference was observed between the treatments. The highest dry matter production of 4825.3 kgha^{-1} was observed with 50 % RN (C.F) + 25% N (GMC) + 25% N(GOC)(T_7). The next best values were noticed in T_{11} (4577.5 kg ha^{-1}) and T_2 (4506.3 kg ha^{-1}) which were received 50% RN(C.F) + 25% N(GOC) + 25%N (PMC) and 100% RDF, respectively. Application of 50 % RN + 25% N(GMC) + 25% N(PMC) (T_9) and 50 % RN(C.F) + 25% N(GMC)+ 25% N(CPC) (T_{10}) registered dry matter production of 4043.0 and 4007.8 kg ha^{-1}, respectively. The treatment T_9 was on par with T_{10}. However, lowest dry matter production of 2876.3 kg ha^{-1} was registered in control (T_1).

At harvest

The highest dry matter production was registered with 50 % RN (C.F) + 25% RN (GMC) + 25% RN(GOC)(T_7) (10394.9 kg h^{-1}), which was followed by 50% RN(C.F) + 25% N(GOC) + 25%N (PMC) (T_{11}) (9969.8 kg ha^{-1}) and 100% RDF(T_2) (9846.1 kgha^{-1}).The treatments T_3, T_4, T_5 and T_6 registered dry matter production of 7804.9, 9435.5, 7809.6 and 8322.7 kg ha^{-1}, respectively. The treatment T_9 was on par with T_{10} similarly the treatment T_9 was on par with T_{10}. However, lowest value was obtained in control (T_1) (6658.1 kg ha^{-1}). This might be due to higher and continuous nutrient availability from sources of nitrogen up to the crop maturity improved the plant photosynthetic activities and caused increase in dry matter accumulation. This was also might be due to better translocation of carbohydrates and their utilization for the production of more leaves with increase in age and nutrient application and the cumulative effect of progressive increase in growth parameters. Similar findings were reported by Parihar *et al.,* (2012) The balanced nutrition due to release of macro and micro nutrients with application of in organics and organics under favourable environment might have helped in higher uptake of nutrients, which accelerated the growth of new tissues and development of new shoots that have ultimately increased dry mater accumulation (Ramdev Togas *et al.,* 2017).

CONCLUSION

In conclusion application of inorganic fertilizers along with composts had positive impact on growth of finger millet and maintained good soil health. Among the treatments imposed, combined application of 50 % RN(C.F) + 25% RN (GLMC) + 25% RN(GOC) registered significantly highest plant height, number of leaves plant^{-1}, number of tillers plant^{-1}, leaf area index and dry matter production of ragi cv. CO 14 grown in sandy loam soil.

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Table 1. Effect of different levels of inorganic fertilizers and different compost on plant height (cm), number of leaves plant^{-1} at different stages of ragi cv.CO14.

Treatments Details		Plant height (cm)			Number of leaves plant^{-1}		
		30 DAT	60 DAT	At harvest	30 DAT	60 DAT	At harvest
T_1	Absolute Control	30.6	49.9	76.7	5.14	6.54	8.20
T_2	100% RDF (N;P_2O_5:K_2O) (60:30:30 kg ha^{-1})	51.8	77.6	108.5	6.96	9.38	10.32
T_3	75% RN(C.F) + 25% RN(GLMC)	38.7	62.1	85.2	5.77	7.71	9.06
T_4	75% RN(C.F) + 25% RN (GOC)	49.2	74.8	104.1	6.73	9.06	10.04
T_5	75% RN(C.F) + 25% RN (PMC)	45.1	70.0	94.0	6.38	8.52	9.64
T_6	75% RN(C.F) +25% RN(CPC)	35.3	57.4	113.4	5.48	7.30	8.74
T_7	50 % RN(C.F) + 25% RN (GLMC) + 25% RN(GOC)	54.7	82.4	81.1	7.29	9.85	10.62
T_8	50 % RN(C.F) + 25% RN(PMC) + 25% RN(CPC),	39.3	62.6	85.9	5.82	7.76	9.11
T_9	50 % RN(C.F) + 25% RN(GLMC) + 25% RN(PMC),	46.4	71.1	99.3	6.47	8.69	9.77
T_{10}	50 % RN(C.F) + 25% RN(GLMC) + 25% RN(PMC)	45.7	70.6	98.1	6.42	8.60	9.71
T_{11}	50% RN(C.F) + 25% RN(GOC) + 25% RN(PMC)	52.3	78.3	109.3	7.02	9.42	10.35
T_{12}	50% RN(C.F) + 25%RN (GOC) + 25% N(CPC)	42.3	66.2	89.2	6.11	8.09	9.35
S.Ed		1.05	1.60	1.80	0.10	0.15	0.11
CD (p=0.05)		2.10	3.20	3.61	0.20	0.31	0.23

Table 2. Effect of different levels of inorganic fertilizers and different compost on number of tillers^{-1} and leaf area index (LAI) at different stages of ragi cv.CO14

Treatments Details		Number of tillers^{-1}			Leaf area index (LAI)		
		30 DAT	60 DAT	At harvest	30 DAT	60 DAT	At harvest
T_1	Absolute Control	1.71	3.25	3.76	1.76	2.20	1.84
T_2	100% RDF (N;P_2O_5:K_2O) (60:30:30 kg ha^{-1})	3.54	5.71	7.26	2.09	3.82	3.01
T_3	75% RN(C.F) + 25% RN(GLMC)	2.42	4.20	5.07	1.88	2.64	2.25
T_4	75% RN(C.F) + 25% RN (GOC)	3.32	5.37	6.35	2.05	3.57	2.85
T_5	75% RN(C.F) + 25% RN (PMC)	2.91	4.89	6.20	1.99	3.19	2.64
T_6	75% RN(C.F) +25% RN(CPC)	2.08	3.76	4.56	1.82	2.39	2.05
T_7	50 % RN(C.F) + 25% RN (GLMC) + 25% RN(GOC)	3.84	6.11	7.81	2.15	4.13	3.21
T_8	50 % RN(C.F) + 25% RN(PMC) + 25% RN(CPC),	2.46	4.24	5.25	1.90	2.70	2.29
T_9	50 % RN(C.F) + 25% RN(GLMC) + 25% RN(PMC),	3.06	5.06	6.41	2.01	3.33	2.71
T_{10}	50 % RN(C.F) + 25% RN(GLMC) + 25% RN(PMC)	3.00	5.00	6.33	2.00	3.26	2.66
T_{11}	50% RN(C.F) + 25% RN(GOC) + 25% RN(PMC)	3.59	5.75	7.32	2.11	3.90	3.05
T_{12}	50% RN(C.F) + 25%RN (GOC) + 25% N(CPC)	2.68	4.58	5.71	1.94	2.94	2.43
S.Ed		0.10	0.16	0.17	0.017	0.08	0.07
CD (p=0.05)		0.21	0.33	0.34	0.034	0.17	0.13

Table 3. Effect of different levels of inorganic fertilizers and different composts on dry matter production

at different stages of ragi cv.CO14

Treatments Details		Dry matter production (kg ha^{-1})		
		30 DAT	60 DAT	At harvest
T_1	Absolute Control	1802.5	2876.3	6658.1
T_2	100% RDF (N;P_2O_5:K_2O) (60:30:30 kg ha^{-1})	2714.7	4506.3	9846.1
T_3	75% RN(C.F) + 25% RN(GLMC)	2026.8	3471.8	7804.9
T_4	75% RN(C.F) + 25% RN (GOC)	2576.1	4277.9	9435.5
T_5	75% RN(C.F) + 25% RN (PMC)	2321.8	3964.2	7809.6
T_6	75% RN(C.F) +25% RN(CPC)	1912.5	3249.8	8322.7
T_7	50 % RN(C.F) + 25% RN (GLMC) + 25% RN(GOC)	2912.5	4825.3	10394.9
T_8	50 % RN(C.F) + 25% RN(PMC) + 25% RN(CPC),	2069.1	3516.7	7920.9
T_9	50 % RN(C.F) + 25% RN(GLMC) + 25% RN(PMC),	2450.5	4043.0	8999.3
T_{10}	50 % RN(C.F) + 25% RN(GLMC) + 25% RN(PMC)	2394.5	4007.8	8884.1
T_{11}	50% RN(C.F) + 25% RN(GOC) + 25% RN(PMC)	2781.2	4577.5	9969.8
T_{12}	50% RN(C.F) + 25%RN (GOC) + 25% RN(CPC)	2183.8	3735.6	8334.7
S.Ed		50.15	112.7	168.9
CD (p=0.05)		100.3	224.4	341.8

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RESEARCH ARTICLE

Integrated Technologies for Effective Wildlife Monitoring in India: A Proposed System

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ABSTRACT

India is rich in flora and fauna and has thus developed a network of protected areas to conserve this socially, economically, and biologically valuable resource. However, India also faces many challenges, making its natural resources as well as those protecting it, vulnerable. These challenges have been exposed further by the pandemic reinforcing the fact that monitoring biodiversity in general and wildlife, in particular, would need constant up gradation in tools, processes, and methods in order to curb the growing menace of their loss. Currently, world over, the technologies being used for wildlife monitoring are camera traps, wireless sensor networks, drones etc. Many of these technologies are being used as stand-alone systems with no real time access to data. In order to enhance their effectiveness,4G network is being used but in a limited way. However, with increased use of technology in wildlife crime, it becomes pertinent to develop more effective systems that would provide multiple, reliable, remote and fast access to data so as to ensure timely action. This paper proposes a system that integrates different existing technologies used for wildlife monitoring. It proposes integration of 5G communication technology to the system for effective and real time transmission of data. The proposed integrated system would consist of camera traps, drones, LoRa (Long Range) based Wireless Sensor Nodes (WSN) that will be spread to cover the entire forest area to not only monitor movement of animals and poachers but would also sense forest fires.

Keywords: 5G technology, Wildlife, Monitoring, WSN, LoRa, Drones, India.

INTRODUCTION

India is rich in flora and fauna. The country constitutes 2.4% of the world's land area, but has7-8% of all documented species of the world which includes over 45,000 species of plants and 91,000 species of animals. Four out of the 34 globally recognized biodiversity hotspots are in India [1]. To conserve the rich resource, India has built a network of 987 Protected Areas (PAs) covering 1,73,053.69 km² or 5.27% of the geographical area of the country [2]. In economic terms, a study of only six tiger reserves in India by IIFM has calculated the flow benefit of 1,202.11 million US$ annually from just these tiger reserves[3]. However, biodiversity in India faces many challenges like habitat loss, pollution, wildlife crime, population pressure, land use change, human-animal conflicts, mining, compensation of loss of natural species with planting non-native species, less effective wildlife monitoring as it is labour intensive, lack of adequate training of forest ground staff, ineffective wildlife laws, climate change leading to extinction of certain species, illegal trade, etc[4],[5],[6]. The impact is clear from the IUCN red list which displays 801 species as either critically endangered, endangered or vulnerable in India while six species are possibly extinct[7]. Also, the rate at which India's forests have grown in the decade before the period 2007 to 2017, if it grows at the same rate then to achieve the target of 33% forest cover it would take more than 180 years [5], thus making India's biodiversity vulnerable. The pandemic that hit the world in December 2019 had a major impact on wildlife and biodiversity as environment was side-lined in the economic recovery during this time, wildlife tourism went down which compromised income and monitoring, habitat destruction increased, nature-friendly laws and their enforcement weakened leading to wildlife crime [8]. The Wildlife Conservation Trust in its report documented 522 cases of wildlife poaching and trade in 2020 alone in India which included 82 incidents of big cats like tigers and leopards, 57 cases of elephants, and nine cases of Rhino poaching as reported from 63 districts of India[9]. The report talks about cases of first-time offenders which is an alarming situation, indicating the rise in the number of people entering the crime which indicates its lucrativeness. UNODC World Wildlife Crime report 2020 has raised alarm bells by pointing out that wildlife monitoring and its survival is not only important for safeguarding environment and biodiversity but is important for human health as well because wildlife poaching and trade is leading to increased transmission of zoonotic diseases, that is, those that spread from animals to humans. The pandemic also made the trade digital[10] thus making it more accessible.

Challenges of wildlife conservation and need for technology in India:

Wildlife conservation remains a daunting challenge in India as space for wildlife is shrinking due to many reasons [4], [5], [6]. As a result, the forest department has incorporated technology to monitor wildlife to not only prevent wildlife trafficking but also to mitigate human-wildlife conflict, help researchers by giving them real time data on movement patterns, habitat mapping and their population, etc, and help in detection of forest fires[11]. Additionally, the safety of the forest staff demands more use of technology rather than letting wildlife monitoring be labour intensive as it is exposing the lives of the ground level staff to various threats from poachers, encroachers, and animals. According to the International Ranger Federation, in India between 2012 and 2017, 162 foresters lost their lives, while on duty. This was the highest numbers of deaths in the world accounting for 31 percent of forest front line deaths across the world during the same period [12]. However, insufficient infrastructure, deficiency of funds and manpower with the forest department [13] or misuse/diversion of funds for non-forestry activities [5] is preventing the active and effective use of technology for wildlife monitoring. Also, where technology is being used, wildlife criminals, who are more organized, are using advanced technology as compared to the protectors of wildlife [14].The challenges of wildlife monitoring in countries like India have been exposed further by the pandemic and has brought out the fact that wildlife monitoring would need constant up gradation in tools, processes, and methods in order to curb the growing menace of wildlife and biodiversity loss. Thus, this paper first looks into contemporary technologies already in use with or without communication technology for wildlife monitoring. Based on the technology already in use, the paper proposes a design of a wildlife monitoring system that integrates the current hardware systems and communication technology that would not only help in data collection but can be useful against poaching and wildlife fires, making it less dependent on human presence on field.

MATERIALS AND METHODS

Contemporary technology in wildlife conservation:

Technological advancements in communication technology have resulted in extensive use of wireless communication which as a technique transmits information or power between two or more points, without being connected with any physical wire/conductor. The most common wireless technology uses radio waves. The role of communication technology becomes more important in wildlife monitoring in today's time as it provides remote and fast access to data so as to take timely action, which is pertinent for wildlife conservation. Currently, world over the technologies being used is camera trapping, wireless sensor networks, GPS device radio collars, Unmanned Aerial Vehicles (UAVs) controlled and managed remotely through embedded autonomous computer programmes, optical sensor and digital camera. Satellite-based systems and communication technology is being used by these systems to transmit real time data. Early-warning technologies have been brought to use in India [15] using 4G that are limited to surveillance of wildlife movement and human interference.

Camera traps and wireless sensor networks (WSN)

Camera Traps are simple, versatile, and have pertinency in a wide range of applications. They are made out of a Passive Infrared (PIR) Sensor which is activated when an animal approaches the camera trap, thus capturing photos, video sequences, and other data. Currently most of the camera traps used in India do not have real time access to data and use cards for storage. This makes access to data human dependent. It also creates a time gap if immediate action needs to be taken as was reported with the nabbing of poachers in Wayanad[16]. Additionally, there have been reports of data management issues, theft by poachers, and damage by animals [17],[18] which may add to the woes of data loss. This can be overcome with the help of WSNs (Wireless sensor networks). WSNsare used to remotely access and/or control devices. They are cost effective and well-developed systems that allow communication over a large area with a network of simple devices [19] thus very useful in wildlife monitoring. This reduces the need for human intervention and thus disturbance in wildlife areas. The WSN allows observation of those parameters that are helpful to determine the health of wildlife area such as habitat and accordingly take necessary actions[20]. They can also be useful in detection of wildfires.

Radio collars and Unmanned Aerial Vehicles (UAVs)

In wildlife monitoring, researchers, world over and in India, are using GPS device radio collars attached to the animal and birds to collect baseline data such as home range sizes, daily movements, animal behaviour and diet[21].The collars/band can be configured with sensors to help detect varied movement activities, temperature, and animal mortality depending on the species. In addition to radio collars, Unmanned Aerial Vehicles (UAVs) are used in India for wildlife monitoring as well, although it has limited usage. These are largely remotely controlled and managed through embedded autonomous computer programs making it more accurate than traditional ground-based counting methods. In the future, extensive use of drone-based surveillance would reduce research cost in terms of time and work force needed for a field survey [22]. Poaching can also be deterred fitting UAVs with night vision lenses and heat sensors.

Optical Sensors, Digital Cameras, and The Global Positioning Technology (GPS)

Optical Sensor and Digital Camera provide high resolution video surveillance for forest fire detection and wildlife monitoring. The equipment used for surveillance often employs image processing to check for certain patterns of fire and smoke in captured images. These systems also provide a live video feed to prevent any false alarms. However, these require extensive laying of optic fiber cables, leading to intervention in natural habitats. In addition, satellite-based navigation system exists which are being used for monitoring in dense forests in India and other parts of the world [23], which gives the location coordinates of a user anywhere on Earth. The Global Positioning Technology (GPS) is a satellite-based system that allows field ecologists to track the position of animal sampling sites, track animal movement, and assess biogeographical trends. High-resolution satellite imaging paired with GPS data has been used to conserve endangered species.

Integration with communication technology: use of 5G over 4G in these systems

Currently, the above stated technologies are inter-linked and operate in a functional network that is mostly driven by 4G communication technological protocols in the world with limited use in India [24]. 4G technology is effectively being used by above systems for establishing connection but introducing 5G will improve the latency rate by thousand times. 5G will also increase by two-fold the total number of devices being run and connected at the same moment for transmission and reception. For example, in case of camera traps 5G can help to achieve faster data transmission, though battery life may be reduced [25]. In case of radio collar, 5G will improve the accuracy of reduce latency. In case of satellite imaging, 5G technology would add new antenna systems, RRC network protocols and architecture and better spectrum utilization [26]. Since UAVs use artificial intelligence, machine learning, and deep learning, combining 5G technology with Zigbee can aid in the transmission of massive amounts of data with greater accuracy and lower latency. [27], [28]. However, 5G is a new technology that has been implemented in many countries across the world which has brought with it certain challenges too such as increased power usage of 5G systems on-board which increases weight. Effects of 5Gin terms of EMF (electromagnetic radiation fields) exposure which may have impact on insect life, navigational abilities of birds, and sustainability of plants [29]. However, with increased used of 5G, researchers are already proposing changes in the technology to reduce its harmful impact[30].

RESULT AND DISCUSSION

Proposed wildlife monitoring system

The current technologies in use for wildlife monitoring are not integrated. This paper proposes a model which not only talks about possibilities of integration of multiples systems that are already in use but also talks about integration of communication technology for effective transmission of data for better monitoring and minimizing the negative impact of high-speed transmission technology. However, the proposed system is not tested on ground and would thus require further research. The system proposed here is forest specific and should satisfy all the stated needs with least resources and should be economical for installation. This system can be deployed in forest areas that are open grasslands, plains and are not dense.

Important features of the proposed system:

The proposed system has LoRa (Long Range) based Wireless Sensor Nodes (WSN) that will be spread to cover the entire forest area. It will have sensors responsible for monitoring animal movements, and for forest fire detection. These sensors will operate in a self-healing and self-organising wireless networking environment. The LoRa technology will also be integrated with the upcoming 5th generation to complement LoRa networks in remote areas both as an access network technology and to backhaul data from gateways to the Cloud or head-end systems [31]. WSNs are very popular and can be used independently for IoT applications. However, due to WSNs two fundamental challenges of high energy consumption and limited coverage area, the WSN performance can be enhanced by using LoRa Based WSN. These characteristics of a LoRa-based Wireless Sensor Network make it appropriate for applications where the network infrastructure must operate autonomously for an extended period of time and across a vast area. [32].LoRa is a hardware which is a star topology for efficient communication and LoRa WAN is a network protocol based on LoRa. LoRa WAN (upper layer protocol) uses the LoRa physical layer and is a set standard over the free-to-use frequency ranges allocated to LoRa. The coverage area of a star configured LoRa network is 22Km for a clear Line of Sight (LOS) and 2Km for regions with obstructions (uneven flora, buildings, etc.). If a dynamic communication link is sustained, the resolution of trajectories can improve to such details, that analysing and tracking comparative locations between two objects in order to observe behaviour may be possible without physical verification from the ground [33]. It is vital to understand that the Lora WAN operates in the unlicensed radio spectrum, which means it can be used without obtaining transmission rights. In most of the countries including India the frequency range for using Lora WAN is specified, e.g., for India it is 865 MHz to 867 MHz [34]. In short, Lora WAN provides Long Range, consumes low power, has 128-bit AES(advanced Encryption Standard) security, is cost-effective and has high capacity. The 5G technology would be used as a backhaul for Lora WAN (meaning of backhaul in this context: to connect network server with Lora WAN gateway). Zigbee, Ethernet,

and satellite, are other solutions that could be used instead of 5G. However, 5G is a better option due to lower latency and faster and higher-quality data transfer. The integration of 5G with LoRaWAN could be done in multiple ways - through 3GPP (3rd Generation Partnership Project) access network, through non-3GPP untrusted access network, as a part of eNodeB, and virtually as a part of core network [35]. These methods are just a few of many. Depending on the needs of the user, established methods can be used or a custom architecture can be created. When integrating 5G with LoRa WAN, security management, authentication, and scalability are the factors that need to be considered. Along with the sensors there will be camera traps which along with their usual functionality will be modified to read RFID (Radio frequency identification) tags fitted on radio collars of tagged animals to reveal information about the animal and its recent sightings. Also drones can be used for controlling situations until human aid arrives.

Proposed system and its working

Figure -1 presents the semantics of the working of the proposed system which integrates various technologies. As give in figure-1, PIR (Passive Infrared) sensors would be interfaced with a group of WSN nodes to form a detection zone and such zones would cover the forest area. The system initially stays in dormant or low power mode till any activity is detected by the PIR sensor. The PIR sensor would act as a switch helping in activating the system from dormant state by sending signal to the camera traps under two circumstances - animal and forest fire detection.

Capturing data

In case an animal (or poachers) comes in the range of PIR sensor, the camera trap would start functioning. Once it is in the range of the camera the lens would click and transmit the image wirelessly over the LoRa WAN – 5G network. Till the time movement is detected, the LoRa WAN network would transmit short burst messages over the backhaul network to maintain connectivity with the cellular network. This keeps the power consumption low. Once the system is activated it would relay the visual data along with various sensor values to the Control room. Also, if the animal is tagged then information about it could be fetched from the GIS (Global Information Server) connected to the application server. Placing GPS sensors on collar tags and WSN nodes would help in creating a spatial map of movements of particular species of animals. This would help in maintaining a proper dataset of animal sightings and their behavioral patterns. In case of forest fires, the End nodes interfaced on the WSNs would constantly monitor the ambient conditions of the forest and update the values into the application server. The values received from the smoke sensor, temperature and humidity sensor, and CO2 sensor will be compared against the pre-fed values in the MCU (micro-controller unit). If they are above the specified threshold level then there is a possibility of forest fire as a result an alert message will be relayed to the control room through the LoRa WAN – 5G network. Also, the coordinates of the location where the spike has been observed will also relayed via the GPS sensors present on the WSN nodes. In order to confirm the authenticity of the alarm raised due to forest fire we would need a visual interpretation which the camera traps would provide of the point from where the alarm was raised. Also, visuals of herd movement of multiple species of animals from one zone to another during such incidences can help in further confirming the wildfire. Once confirmed, drones could be sent to the coordinates to understand the spread of the fire till human-aid arrives.

Relay data

The data thus received from the sensors will be sent to the nearest LoRa base station which will be transmitted to the LoRa gateway. The LoRa gateway would comprise of a LoRa transceiver module on a MPMC (Microprocessor Microcontroller). In addition, the gateway will also have network connectivity to transfer the data received at the gateway to a local network server or to send the same to the cloud. Between the network server and the gateway there is a backhaul which in this case can be 4G or 5G. The programmable switch can be programmed to detect the available wireless network and provide option to the user to switch between the available networks as desired. The official in charge of the control room will have remote access to the switch, allowing him to configure the type of wireless technology required (4G/5G) according to the specifications. This can help to transmit data over a low radiation network such as 4G. The data would be received by the control room which will have a dashboard-style display on computers where officials will be able to watch and observe animals, their movements, and other

information. There will be continual alarms/ alerts in the event of forest fires to alert officials to send a drone to the location. The architecture used for our system is via 3GPP (3rd Generation Partnership Project) access. In this SI (serial interface) is used as the communication interface which would further generate general packet radio service. The information regarding LoRa WAN must be defined in the home subscriber service (HSS) data base, which is coupled to the mobility management entity (MME), for authentication and permission (MME). The MME updates the subscriber's location in HSS based on the current status of the user by sending an update location request that includes the PLMN identifier, i.e., mobile network code (MNC) and mobile country code (MCC). The data would be sent to the network server which manages gateways, end-devices, applications, and users in the entire Lora WAN network. The Application Server would process application-specific data messages received from end devices. The obtained data can be interpreted using techniques such as machine learning and artificial intelligence. [36].

CONCLUSION

Advancement in technology has added to the convenience of human life but it also been one of the reasons for accelerating the speed of exploitation of natural resources and wildlife being one of them. This is because human economic growth has always taken precedence over natural resource protection. But with alarming decline in natural resources and its adverse impact on human life, humans have shifted some of their focus towards developing technology to protect natural resources. As a result, technology for biodiversity monitoring, especially animal monitoring is witnessing fast developing trends in terms of techniques and applications to increase the coverage for tackling numerous problems. In natural resource rich countries like India where wildlife monitoring and funding for the same are still facing challenges, the need of the hour is of developing/evolving effective systems that integrate all the existing technologies, rather than developing new technology.

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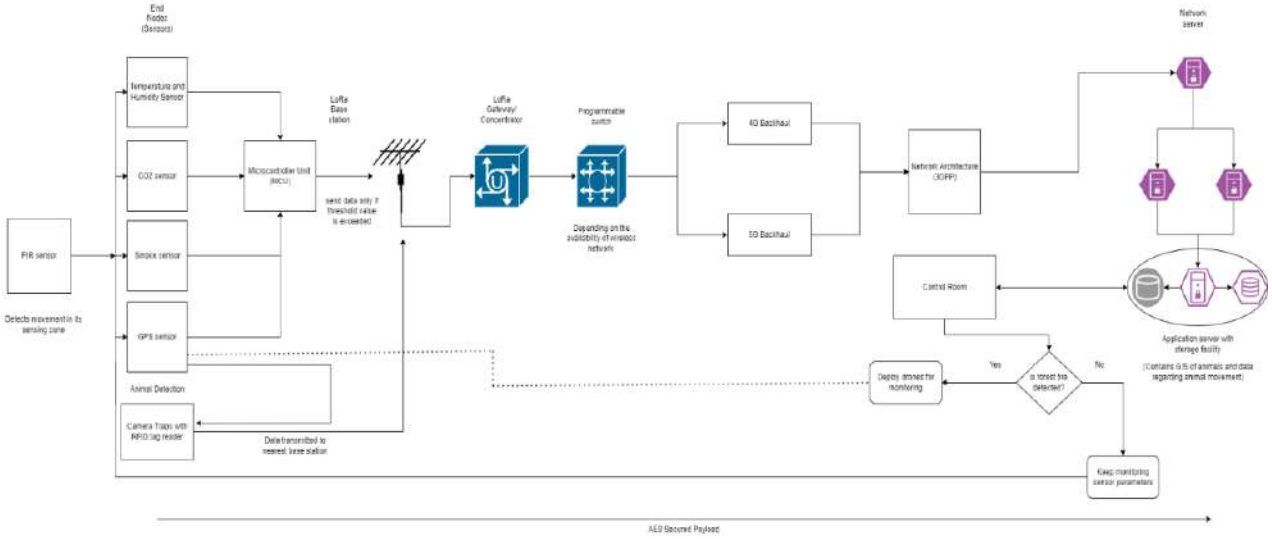

Figure 1. Proposed Wildlife integrated monitoring system

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RESEARCH ARTICLE

Effect of Yogic Practices on Heart Rate and Fasting Blood Sugar Among Middle Aged Type 2 Diabetic Women

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ABSTRACT

The goal of study on experimental through random selection was to find out how Yogic Practices on Heart Rate and Fasting blood sugar among middle aged type 2 Diabetic Women. 30 middle aged women suffering with Diabetic aging 35 to 45 years were randomly taken from Chennai and divided into two groups I, and II with 15 subjects each. It was hypothesized to have substantial differences in Heart Rate and Fasting blood sugar between the groups than the control group. Before the start training, Preliminary test conducted for two Groups on Heart Rate and Fasting blood sugar were noted. Group I subjects were given Yogic practices for 60 minutes, six days a week fortwelve weeks. Group II were in active rest and had to lead the routine. After the experimental period, the two groups were retested again on the same variables. Analysis of co-variance (ANCOVA) was used to find out the significant differences between the experimental group and the control group. The test of significance was fixed at 0.05 level of confidence. The results of the study proved that the Experimental Group showed substantial differences on Heart Rate (decreased) and Fasting blood sugar (reduced) compare to the Control Group. At 0.05 level of

confidence, the hypothesis was accepted. Hence it is concluded that Yogic practices are beneficial middle aged type 2 Diabetic Women to Heart Rate and Fasting blood sugar to lead healthy life.

Keywords: Yogic Practices, Heart Rate, Fasting blood sugar, Diabetes, Middle aged Women**.**

INTRODUCTION

Now modern science says there is no positive process for Diabetes Mellitus. The disease itself, is commonly un-affected by this, but may even increase in severity. The cause and reason of Diabetes is unknown, but heredity and diet play an important role in its development. Diabetes results when the pancreas not produce sufficient amounts of insulin, but the cells not able to use it effectively, so the cells have been insulin resistance. Insulin is essential for blood glucose to go in side of the cells and unless the glucose enters into the cells, the body stop produce energy. Then the excess sugar remains in the blood. Diabetes Mellitus is an endocrine disorder. The ancient science of yoga has successful management is thousands of years old. Yoga is based on the physical system internal adjustment through stimulation and regenerative of the body's by own process. After many years with sufferers of diabetes by giving them yogic method .Last few years, Yoga has more popularity and now over 30 million people practices Yoga regularly. Yoga is one of the most quick health activities growing today, despite existed already for many years. Today People's move their attitude towards way of life, health, spirituality, and in society dramatically changed.

Key Facts of Diabetes Population

As per IDF Diabetes Atlas, Globally – 2019 - 9th Edition report said - Global diabetes projections and estimates, 7.7 billion in total world population. It had grown 88% to 285 million in 2009. Recently, 9.3% of adults are under aged 20–79 years - a staggering Global Prevalence 9.3% (463 million people) – are living with diabetes. This number is will be increase to 578 million (10.2%) in 2030 and further increase to 700 million (10.9%) in 2045.

Causes of Type 2 Diabetes

Inadequate or no secretion of insulin by pancreas. Cells and organs may not utilize the insulin to convert glucose into energy to meet their requirements.

Hereditary factor, Metabolic syndrome, Fasting blood sugar, Insomnia, Constipation, Lack of dietary control, Too much glucose from liver , Bad communication between cells , Broken beta cells, Extra weight due to lack of physical exercise are the causes of diabetes.

Symptoms of Type 2 Diabetes

The symptoms of type 2 diabetes about 8 million people who have it don't know it. Symptoms include: Frequent urination – Polyuria, Excessive thirst – Polydipsia, Increased hunger/ appetite – Polyphagia, Sudden loss of weight, Tiredness, Lack of interest and concentration, Blurred vision Tingling sensation or numbness in hands and feet, Frequent infections, Slow healing wounds and Black patches in skin.

Complications

Diabetes of all types can lead to complications in many parts of the body and can increase the overall risk of dying prematurely. Possible complications include heart attack, stroke, kidney failure, leg amputation, vision loss and nerve damage. In pregnancy, poorly controlled diabetes increases the risk of fatal death and other complications.

Objectives of the Study

- To find out whether there would be any significant difference on Heart Rate due to yogic practices among middle aged type 2 Diabetic Women.
- To find out whether there would be any significant difference on Fasting blood sugar due to yogic practices among middle aged type 2 Diabetic Women.

Statement of the Problem

The purpose of the study was to find out the effect of yogic practices on Heart Rate and Fasting blood sugar among middle aged type 2 Diabetic Women.

Hypothesis

It was hypothesized that there would be significant differences on Heart Rate and Fasting blood sugar among middle aged type 2 Diabetic Women due to yogic practices than the control group.

Delimitations

The study aredelimited only to the Middle aged women suffering with Diabetes from Chennai city, India, The age group of the subjects was aged between 35 and 45 years only. Research was delimited to Yogic practices only. The dependent variablesare Heart Rate& Fasting blood sugaronly.

MATERIALS AND METHODS

To achieve the purpose of the random group experimental study 90 Middle aged women suffering with Diabetes aged between 35 and 45 years were invited, they were screened into 60 subjects and finally through random group sampling method 30 subjects were selected randomly. They divided into two groups. One group was given yogic practices and the other was taken as control group. The dependent variables chosen are Heart Rate and Fasting blood sugar. Random group experimental design was used. The practice of yoga techniques like 1. Loosening Exercises, 2. Suryanamaskar, 3. Asanas:Padahasthasan, Sarvangasan, Halasan, Dhanurasan, Matysasana, Arthamachendrasan ,Mandukasana, Paschimottasan and Shashangasana, 4. Pranayama : Kapalabhati, Basthirika and Nadishodana, 5.Yoga Nidrahelps to overcome any imbalances and creates harmony in the physical, mental, Psychologically and spiritual aspects of human personality. The experimental group underwent training period of Six days per week for the maximum of an hour in the morning for twelve weeks and the control group did not undergo any training. The Analysis of co-variance (ANCOVA) was used as a statistical technique to find out the significant mean differences between the groups. The level of significance was fixed at 0.05%.

RESULTS AND DISCUSSIONS

The data pertaining to the variable collected from the two groups before and after the training period were statistically analyzed by using Analysis of Co-variance (ANCOVA) to determine the significant difference and the hypothesis was tested at 0.05 level of confidence.

These are following tables detailed

The obtained F value on pre test scores 0.09 was lesser than the required F value of 4.2 to be significant at 0.05 level. This proved that there was no significant difference between the groups a pre-test and post-test and the randomization at the pre-test was equal. The post test scores analysis proved that there was significant difference between the groups, as obtained F value 254.77 was greater than the required F value of 4.20. This proved that the differences between the post test means of the subjects were significant. Taking into consideration the pre and post test scores among the groups, adjusted mean scores were calculated and subjected to statistical treatment. The obtained F value 259.18 was greater than the required F value of 4.21. This proved that there was a significant difference among the means due to twelve weeks of Yoga Practices on Heart Rate in line with the study conducted by Sivasankaran S *et.al.,* (2008).The ordered adjusted means on Heart Rate were presented through bar diagram for better understanding of the results of this study in Figure - I

The obtained F value on pre test scores 0.17 was lesser than the required F value of 4.2 to be significant at 0.05 level. This proved that there was no significant difference between the groups a pre-test and post-test and the

randomization at the pre-test was equal. The post test scores analysis proved that there was significant difference between the groups, as obtained F value 183.38 was greater than the required F value of 4.20. This proved that the differences between the post test means of the subjects were significant. Taking into consideration the pre and post test scores among the groups, adjusted mean scores were calculated and subjected to statistical treatment. The obtained F value 421.88 was greater than the required F value of 4.21. This proved that there was a significant difference among the means due to twelve weeks of Yoga Practices on Fasting Blood Sugar in line with the study conducted by Shantakumari, Nisha *et.al.,* (2012).The ordered adjusted means on Fasting blood sugarwere presented through bar diagram for better understanding of the results of this study in Figure - II. The outcome of the study exhibits that Heart Rate decreased and Fasting blood sugar reduced significantlyduetoYogicPracticesforGroup-IthanGroupII.Hencethehypothesiswasaccepted at 0.05 level of confidence. The findings were also substantiated by the observations made by the expert Sivasankaran S, *et.al.,*(2008) and Shantakumari, Nisha *et.al.,* (2012).

DISCUSSION ON HYPOTHESIS

It was hypothesized that there would be significant differences on selected Physiological variable such as Heart Rate and Bio-Chemical variable such as Fasting blood sugar due to Yogic Practices among Experimental Group than the control group. The results proved that there were significant differences on Heart Rate (Decreased) and Fasting blood sugar (Decreased) due to Yogic Practices than the control group among middle aged type 2 Diabetic Women at 0.05 level of significance.

CONCLUSION

It is concluded that Yogic Practices Heart Rate (Decreased) and Fasting blood sugar (Decreased) due to Yogic Practices among middle aged type 2 Diabetic Women . Hence, Yogic practices are good for middle aged type 2 Diabetic Women to maintain healthy Heart Rate and Fasting blood sugar.

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Table 1. Analysis of Covariance of the means of Experimental Group and Control Group on Heart Rate (Beat/min)

Mean	Exp. Group	Control group	Source of Variance	Sum of Squares	df	Mean Squares	Obtained F
Pre-Test Mean	99.87	100.27	Between	1.20	1	1.20	0.09
			Within	378.67	28	13.52	
Post Test Mean	78.07	100.60	Between	3808.13	1	3808.13	254.77*
			Within	418.53	28	14.95	
Adjusted Mean	78.12	100.55	Between	3760.34	1	3760.34	259.18*
			Within	391.74	27	14.51	
***Significant at 0.05 level of confidence. (Table F-ratio at 0.05 level of confidence for df 1 at 28= 4.2 and for df 1 at 27 =4.21)**							

Table 2. Analysis of Covariance of the means of Experimental Group and Control Group on Fasting Blood Sugar (mg/dL)

Mean	Exp. Group	Control group	Source of Variance	Sum of Squars	df	Mean Squares	Obtained F
Pre-Test Mean	135.53	136.47	Between	6.53	1	6.53	0.17
			Within	1093.47	28	39.05	
Post Test Mean	105.67	136.53	Between	7145.63	1	7145.63	183.38*
			Within	1091.07	28	38.97	
Adjusted Mean	106.03	136.17	Between	6773.99	1	6773.99	421.88*
			Within	433.53	27	16.06	

***Significant at 0.05 level of confidence. (Table F-ratio at 0.05 level of confidence for df 1 at 28 = 4.2 and for df 1 at 27 =4.21)**

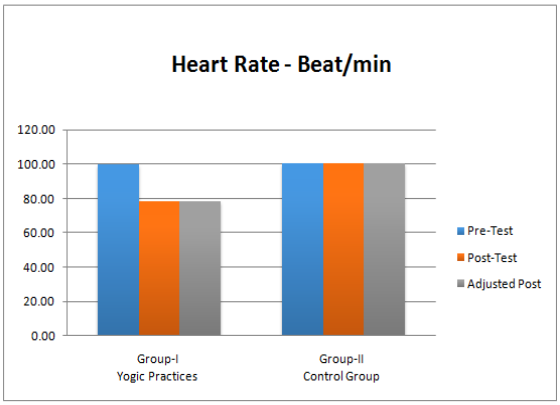

Figure 1. Bar Diagram showing Mean Differences among the Groups on Heart Rate (Beat/min)

***Significant at 0.05 level of confidence. (Table Fratction 0.05 level of confidence for df 1 and28= 4.2 and 1 and27 =4.21)**

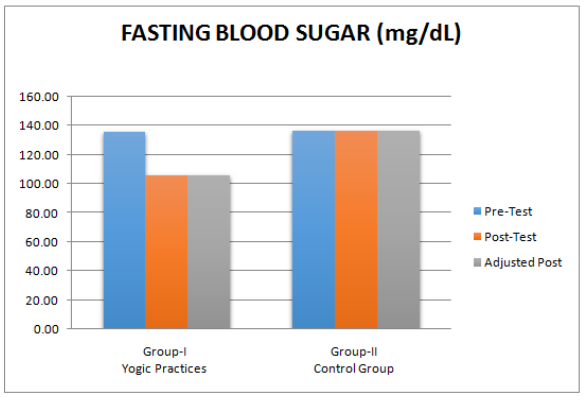

Figure 2. Bar Diagram showing Mean Differences among the Groups on Fasting Blood Sugar (mg/dL)

***Significant at 0.05 level of confidence. (Table Fratction 0.05 level of confidence for df 1 and28= 4.2 and 1 and27 =4.21)**

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RESEARCH ARTICLE

Synthesis, Characterization and *In vitro* Release Study of Lupeol Encapsulated Chitosan Nanoparticles

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ABSTRACT

The main objective of this study is to determine the most effective conditions for the preparation of chitosan nanoparticles encapsulated with lupeol (Lup@CS-NP). Using three different weight percentage of chitosan with polyanion sodium tripolyphosphate (STPP) as a cross-linking agent, lupeol encapsulated chitosan nanoparticles were prepared using the ionic gelation technique. The preparation was based on the ionic interaction of positively charged chitosan and negatively charged polyanion sodium tripolyphosphate. UV-visible spectroscopy and Fourier transform infrared (FTIR) confirmed successful encapsulated of lupeol in prepared chitosan nanoparticles. In the range of 76-94%, the entrapment efficiency (EE %) of chitosan nanoparticles was found and EE % was increase with increasing lupeol concentrations. Moreover, the sustained release from the nanoparticles was found to be slower when higher molecular weight chitosan was used, thereby showed the *in vitro* drug release capacity of lupeol from selected formulations. The study of drug release kinetics revealed that the release of lupeol from chitosan nanoparticles followed a diffusion-controlled method.

Keywords: Chitosan, Lupeol, Ionic gelation, Encapsulation and *In vitro* drug releasing study

INTRODUCTION

Natural products often excel in the medical field. Natural medicine has been a source of healing agents for thousands of years, although many modern medicines are derived from nature [1]. Unfortunately, these natural medicines were limited in its clinical trials because of poor solubility, low bioavailability, and decreased sustainability [2]. These

medicines need extensive testing to enhance their bioavailability due to poor absorption or non-targeted delivery. Therefore a consistent scientific strategy is required to carry out to overcome these drawbacks. Lupeol is one of such active phyto medicine, which has a wide range of biological activities including anticancer, anti-inflammatory and antioxidant properties, present in many fruits and vegetables such as mango, olive and fig. Although, this potent phyto molecule has varied biological properties its clinical trials were indulged by some limitations such as non-specificity that leads to systemic toxicity as well as it has very low bioavailability, low solubility and short plasma half-life [3]. The interest in investigating nanotechnology in the field of drug delivery has increased considerably in recent years. The drug incorporation into polymeric nanoparticles is one of the options to overcome these weaknesses. Polymeric nanoparticles can also enhance the bioavailability of drugs [4]. The drug delivery carriers have special features, such as the ability to change their surface properties and the capability to retain improved solubility, increased bioavailability and enhance the life of the substance attached [5]. Using several types of polymers, nanoparticulate drug delivery carriers can be formulated [6]. As drug delivery nanocarriers, a variety of biodegradable polymers have been investigated for their nano potential [7, 8]. Chitosan [poly-(1-4)-2-amino-2-deoxy-β-D glucan] is a cationic biopolymer developed by alkaline N-deacetylation of chitin, which is the main component of the shells of crab, krill, and shrimp [9-12].The small size of CS-NP provides a large surface area of contact with the molecule of nanoparticles, thus enhancing the function [13, 14]. Due to its excellent properties has good biocompatibility and biodegradability, application has been broadly studied in application has been broadly studied in chitosan nanoparticles as a carrier for drugs, proteins and peptides [15, 16].In addition, some studies have suggested that the drug release profile of these nanocarriers can be modified by adjusting the molecular weight and degradation rate of the chitosan used in their formulation [17].Therefore, the current research aims to investigate the synthesis and characterization of lupeol encapsulated chitosan nanoparticles (Lup@CS-NP)by ionic gelation method. Moreover the blends were characterized, using UV-Visible spectroscopy, and Fourier transform infrared spectroscopy (FTIR), and the incorporation of lupeol into the prepared nanoparticles was also evaluated. The *in vitro* drug release pattern was also performed from prepared nanoparticles as well as release kinetics analysis.

MATERIALS AND METHODS

Materials

Chitosan were obtained from Sigma-Aldrich, India. Lupeol and sodium tripolyphosphate were obtained from Sigma-Aldrich, India. All other chemicals otherwise mentioned were of analytical grade.

Preparation of chitosan-lupeol (Lup@CS-NP) nanoparticles

Chitosan was encapsulated in lupeol (Lup@CSNP) according to the method used in previous study[18].0.5 g of chitosan in acetic solution (2%) was precisely weighed and dissolved to obtain a final concentration of 2.0% (w/v). Different proportions of lupeol (25%, 50% & 100%) were added to final uniform chitosan polymeric solution under magnetic stirring for 1 hour. The obtained chitosan-lupeol precipitate had washed with distilled water, centrifuged for 10 minutes at 10000 rpm, and then dried for 12 hours at 65^{o}C in an oven to obtain purified Lup@CSNP nanoparticles. The schematic diagram for the Chitosan synthesis and encapsulation of lupeol with chitosan are presented in Figure-1.

CHARACTERIZATION (LUP@CS-NP)

UV-Visible spectroscopy.

UV-visible absorption spectra and diffuse reflectance spectra (DRS mode) of the samples were obtained by employing Shimadzu UV-2600 UV-vis spectrophotometer in the range of 350-900 nm.

Fourier Transform Infrared (FTIR).

Fourier transform infrared (FTIR) spectroscopic analysis (ALPHA-T-FT-IR Spectrometer) was performed from 4000 to 500 cm^{-1} to confirm the chemical interactions within the present in the chitosan-lupeol (Lup@CS-NP) nanoparticles. The synthesized Lup@CSNP nanoparticles were dried at 30 °C and then ground with KBr.

Determination of encapsulation efficiency

The combined washes after centrifugation are diluted appropriately using 0.5 % acetic acid to assess the encapsulation efficiency percentage of lupeol in the prepared nanoparticles. Using the regression equation of the standard calibration curve plotted using acceptable lupeol concentrations the amount of free, unencapsulated lupeol was calculated spectrophotometrically at 265.2 nm. The amount of lupeol encapsulated was calculated by the difference between the amount of lupeol free, unencapsulated in the combined washings and the initial amount used for chitosan nanoparticles preparation where the following equation was used. The encapsulation efficiency (EE) and loading capacity (LC) of Lup@CSNP were calculated from equation (1) and (2) respectively.

$$EE\% = \frac{\text{Free drug} - \text{Total drug}}{\text{Total drug}} \times 100 \quad \text{——————} \quad 1$$

$$\text{Loading Capacity} = \frac{\text{Drug}_{\text{Total}} - \text{Drug}_{\text{Free}}}{\text{Weight of nanoparticles}} \times 100 \quad \text{——————} \quad 2$$

Drug releasing studies

The study of *in vitro* drug release was performed using the dialysis membrane system[19].10 mg of Lup@CSNP (25%, 50% & 100%) were placed separately in the dialysis tubing cellulose membrane at a concentration of 1 mg/mL in buffer solution and were incubated at 37°C with 50 rpmagitation in 500mL of phosphate-buffered saline (pH 4.8 and 7.4).An aliquot of 5mL of the release media was removed at fixed time intervals (0, 5, 10, 15, 20, 25, 35, 45, 55, 65 & 75 hours) and the dissolution medium was replaced with a fresh buffer (5mL) to maintain a constant amount [20].Using a double beam UV-visible spectrophotometer, the lupeol (Lup@CSNP) concentration in the release media was determined at 257nm (Evolution 300; Thermo Fisher Scientific, USA). The absorption intensity was plotted against time, which gave a Lup@CSNP desorption profile.

RESULTS AND DISCUSSION

UV–visible spectroscopy

The UV–visible spectrum profile of Lup@CS-25%, Lup@CS-50% and Lup@CS-100% nanoparticles is shown in Figure-2. The profile showing the peak at 290 nm was recorded for chitosan nanoparticles, which correspond to the lupeol confirming the encapsulation of Lup@CS-NP (25%, 50% and 100%) nanoparticles. The absorbance intensity of the Lup@CS-NP nanoparticles increased, showing that the encapsulation of lupeol into the chitosan nanoparticles pushes the absorption of Lup@CSNP nanoparticles to a longer wavelength.

Fourier transform infrared spectroscopy

The Fourier transform infrared spectra of lupeol encapsulated chitosan nanoparticles (Lup@CS-25%, Lup@CS-50% and Lup@CS-100%) are shown in Figure-3.As shown in the functional group such as -OH stretching at 3368 cm^{-1} related to alcoholic/phenolic groups, -C-O-C symmetric and asymmetric stretching vibrations at 1162 cm^{-1}, C=O stretching vibration of the ester group at 1660 cm^{-1}, and -C-C- stretching vibration of alkanes at 1426 cm^{-1} respectively to lupeol. FTIR spectral analysis of STPP showed strong P=O stretching vibrations at 1163 cm^{-1} and stretching at P-O 899 cm^{-1} and 727 cm^{-1}. The main characteristic absorption bands in chitosan appeared at 1550 cm^{-1} and the N-H bending vibration and C-O stretching of the alcohol group were assigned to 1380 cm^{-1}. The C-N, N-H and C-H stretching vibrations were assigned to the bands at 1032 cm^{-1}, 3436 cm^{-1} and 2927 cm^{-1}, respectively. The observed chitosan peak was assigned to the N-H stretching at 3436 cm^{-1} and the change to the interior at the same spectral peak (3368 cm^{-1}) in the Lup@CSNP nanoparticles confirms the formation of lupeol with chitosan. The resulting complex also showed a lack of C=S (1202 cm^{-1}) and C-N (1373 cm^{-1}) lupeol-related spectral peaks in the Lup@CSNP nanoparticles, likely due to the interaction of lupeol with chitosan. The decrease in the frequency of stretching and

the absence of the spectral peak may be due to the strong involvement of that functional group in the formation of bonds, indicating without any structural changes the encapsulation of lupeol to chitosan.

***In vitro* drug release studies**

The *invitro* drug releasing profiles of the studied Lup@CSNP-25%, Lup@CSNP-50% and Lup@CSNP-100% nanoparticles are displayed in Figure-4,the figure shows that drug release profile of 25%, 50%, and 100% lupeol infusion increase the release of the same under body nature fluid. It is around 35%, 48%, and 54% as lupeol rises from 25%, 50%, and 100% after 20 hours of interaction exposure. Lower lupeol content, higher release amount at the beginning and then balanced over a period are also observed. Faster desorption rate in the initial duration of 5 hours at 100% loading, followed by sustained release after 55 hours. As a result, due to the slow diffusion rate, long time-controlled drug release was found in the 100% Lupeol-encapsulated chitosan nanoparticles.

Determination of encapsulation efficiency

The initial concentration of lupeol plays an important role in the encapsulation efficiency (EE) and loading capacity (LC) of Lup@CSNP-25%, Lup@CSNP-50% and Lup@CSNP-100% nanoparticles (Table-1). When the concentration of lupeol is maintained unchanged, the EE of lupeol increase in lupeol concentration leads to an increase of encapsulation efficiency and loading capacity. When lupeol initial concentration is fixed, encapsulation efficiency and loading capacity of lupeol are increase from 79.29%, 93.28%, 96.95% and 20.81%, 34.36%, 36.98% respectively. It was found that the EE and LC are higher than that of lupeol when the initial concentration of lupeol, which could be attributed to the fact that lupeol is more hydrophilic than lupeol and is more likely to interact with CS in aqueous medium.

CONCLUSION

In this work, Lup@CSNP nanoparticles were successfully prepared. Compared to conventional dosage types, nanoparticulate drug delivery systems represent a promising technique of apparent superiority because they have the potential to improve drug bioavailability and permeability. In the present research, ionic gelation was used to prepare lupeol-encapsulated chitosan nanoparticles where several parameters that affect the preparation and characteristics of the nanoparticles were investigated, such as chitosan, and chitosan concentration: STPP mass ratio. Nanoparticles were successfully formed at an STPP concentration of 2 mg/ml with the investigated chitosan concentration. The results of UV-Visible spectroscopy and FTIR studies indicated that lupeol was incorporated into the prepared nanoparticles of chitosan. Lupeol's release from nanoparticles was biphasic and followed a kinetic model focused on diffusion. Using chitosan was also found to result in a slower release of drugs. The results obtained would help to understand the impact of different factors on the efficient formulation of polymeric nanoparticles based on chitosan for effective delivery of lupeol.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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Table 1. Encapsulation and loading efficiency of Lupeol in to chitosan nanoparticles determined by UV-Visible spectrophotometry

Concentration of Lup@CS (mg)	Concentration of Lup (mg)	Encapsulation efficiency (wt %)	Drug Loading (wt %)
Lup@CS-25%	25	79.29±1.92	20.81±1.83
Lup@CS -50%	50	93.28±1.14	34.36±1.54
Lup@CS -100%	100	96.95±1.51	36.98±1.71

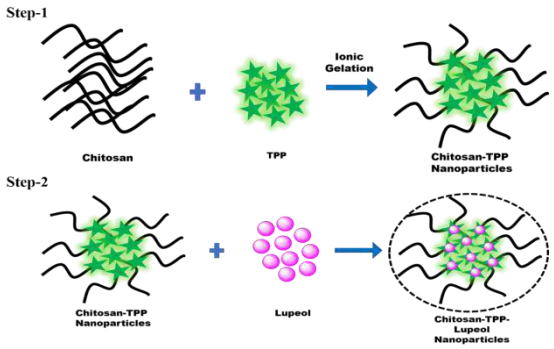

Figure 1. Schematic diagram showing prepare of lupeol encapsulated chitosan nanoparticles (Lup@CS-NP) by ionic gelatine method.

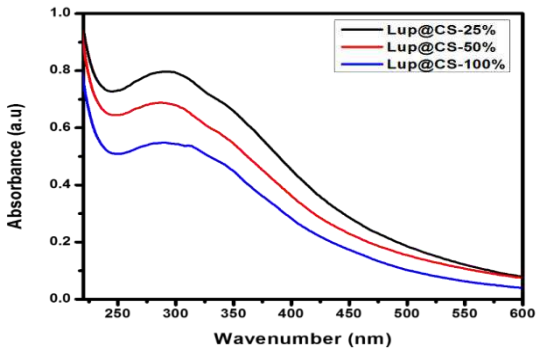

Figure 2. UV-Visible spectra of Lup@CS-25%, Lup@CS-50% and Lup@CSNP-100%.

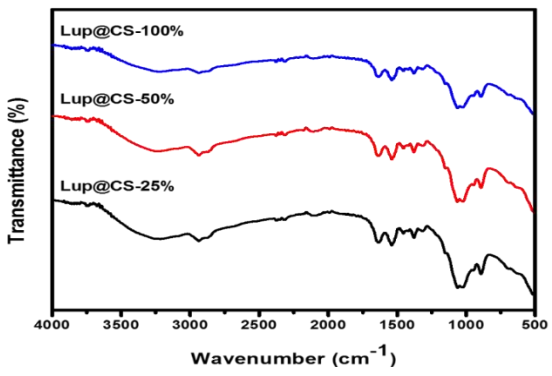

Figure 3. FTIR spectra of Lup@CSNP-25%, Lup@CSNP-50% and Lup@CSNP-100%.

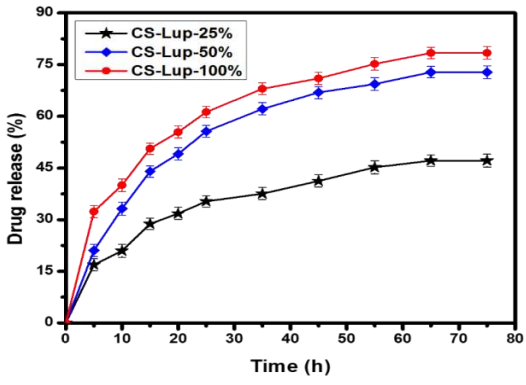

Figure 4. *In vitro* release profiles of lupeol and CS nanoparticles (Lup@CSNP-25%, Lup@CSNP-50% and Lup@CSNP-100%) in PBS.

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RESEARCH ARTICLE

An Experimental Study on the Effects of Mobile Tower Radiation on Breeding of Birds

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ABSTRACT

Microwave radiation causes serious issues to humans, animals, birds, and other living organisms. In this study, we examined experimentally whether mobile tower radiation has any relevant relationships with the breeding of birds. Two methods are accustomed to determine the relation between the breeding of birds and cell tower radiation. In the first experiment, collected fertilized eggs of four birds - chicken, duck, quail, and crow. Repeated thrice at three locations in India and Finland. In the case of chicken and duck, no meaningful relation was found between their breeding and cell tower radiation. But mobile tower radiation plays a major role in damaging the eggs and embryos of quail and crow. Difficulties aroused in collecting large quantities of eggs of other bird species from the wild. Moreover, we never intended to disturb their lives. So we tried another method to look at the relationships in other birds. Shielding effectiveness measurement could be a proven scientific method to search out the capacity of an enclosure to scale back the share of penetration by microwave radiation. Collected broken egg shells after hatching from sixteen bird species and determined their shielding effectiveness. Compared with the primary experimental results. Our study confirmed that tiny birds having lesser egg shell thickness have lesser shielding effectiveness and their don't seem to be safe even at a distance of 1 km from a cell tower.

Keywords: Mobile tower radiation, birds, breeding , crow, microwave , radiation exposure, RF exposure.

INTRODUCTION

One of the foremost technologies of recent man is telecommunication. Among these, cellular technology is the one that has drastically changed the globe within the last twenty years. Higher bandwidth internet connections are now possible with the introduction of 4G and 5G. As of 2017, about 73% of the world's population is using cell phones [1]. A part of the radio frequency spectrum is utilised for cellular technologies, which comes under Non ionising

Radiations (NIR).NIR is also a part of the electromagnetic spectrum which has no power to expel electrons from the shells and ionise matter. It seems less harmful compared to ionising radiations. But long-term exposure to NIR also may cause serious effects on living things [2]. The latest note published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP), constituted by World Health Organisation (WHO), on their website (ICNIRP Note 2019) [3] declares "clear evidence" that radio frequency is "carcinogenic". The results available are from two large animal studies investigating the long-term exposure to radiation from either mobile phones or base stations. These studies are from US National Toxicology Program (NTP) and Ramazzini Institute, Italy. The International Commission on Non-Ionizing Radiation Protection (ICNIRP) evaluates these studies and declares that these studies have "important Strengths" and have "Clear evidence". This is often the first time in its history that ICNIRP openly agrees on the harmfulness of long-term exposure from cell towers and base stations. A report named Bio initiative Report, prepared by thousands of scientists around the world, after careful studies on this subject, concluded that the prevailing RF exposure standards in the world are not sufficient to shield the globe from the ill effects of radiation[4]. Guidelines were issued by the ICNIRP to limit the radiation exposure from NIR under 300 GHz. The exposure effects on the living matter are of two types - thermal effects and non-thermal effects [2].

Thermal Effects

The heating of living matter by absorption of energy from the exposed microwave fields is termed thermal effects. When aanimate thing is placed under radio frequency exposure, it will absorb radiation, because the living matter constitution contains quite 70% of liquid. The radiation in the microwave range exerts a force on the electric dipoles of the water molecules. This force causes the molecules to vibrate at the applied frequency producing heat. This is the principle used in the microwave oven also.

Non thermal Effects

The heating of living matter by absorption of energy from the exposed microwave fields is termed thermal effects. The effects due to the coupling of electric and magnetic fields inside a living matter are termed non-thermal effects. Living matter could be a good conductor. The exposed field will induce voltage and currents in living things by electromagnetic induction. It also forms electric dipoles inside the body or reorients the existing dipoles in living matters. The electric field forces charges in the conducting tissues to move. The magnitude of these effects will depend on the electric conductivity and permittivity of the body tissues, the type of tissues, and their orientation towards the exposure fields. The induced current inside the body parts will depend on the size and shapes of the exposing body parts and their orientation to the exposure fields. The coupling of magnetic fields induces electric fields and circulating electric currents (Eddy Currents) inside the exposed living matter. Eddy currents are currents, circulating in conducting loops, induced by a time-varying magnetic field, according to Faraday's law of Induction. Eddy current flows in closed loops within the exposed conductors in the plane perpendicular to the applied magnetic field. Eddy current, in turn, creates another magnetic field, which opposes the applied field according to Lenz's law and Ampere's circuital law. The transfer of nutrition from blood to the tissues is through narrow capillary walls. The force exerted by the exposure fields may damage these walls. Also, the induced voltages and currents may affect the communication through the nerves in the human body. Many studies confirmed the ill effects of microwave radiation. The brain is protected from the blood by a blood-brain barrier (BBB), which selectively allows the nutrients to pass through it, from blood to brain, but keeps toxic substances out [5],[6]. But experiments in the Young lab found that the cell phone radiations open the BBB, which allows the albumin to come in to in appropriate places in the brain. A study by BahriyeSirav and NesrinSeyhan of Gazi University (2016) found a significant increase in albumin in the brain of rats after giving them a sufficient amount of RF exposure [3]. Other studies which also concluded with similar results are [7], [8], [9] made a clear analysis on the exposure effects on the brain and suggested some effective methods for prevention using antioxidants [7] also refers to the same issue. There are so many other studies that also reported the same fact. Some of them are included in the reference [10] – [14],[16],[37]-[42].

It has been found in several studies that electromagnetic fields release calcium ions bound to the cell membranes and can develop temporary pores and leaks. The leaked calcium ions in the cytosol fluid which stimulate growth and

healing it also cause brain tumuors. The ions degrade the signal-to-noise ratio of the brain to respond to the weak stimuli. This also leads to neurological disorders in the brain. The recent studies that reported these findings include Dimitris 2019 [15] and [17] - [29].

Microwave frequencies even below the ICNIRP and FCC standards can affect and damage the DNA. Studies reported that RF exposure causes single and double-strand breaks in DNA. [30] – [35]. The electromagnetic field causes membrane leakage due to the loss of calcium ions. Leaks in the lysosomes (small tissue containing digestive enzymes which can destroy DNA) cause breaks in DNA [36]. Microwave radiation causes serious issues to humans, animals, birds, and other living organisms[37]-[43]. Nair Sravan Surendran, Nihal Anwar S, etc. reveals the radiation's harmful effects on Sparrows, Pigeons, Swans, etc [45]. Devendra Kumar Durgam, Shweta Sao, and R. K. Singh found the effect of mobile tower radiation on birds in Bijapur district, India [46]. R.Bhattacharya and R. Roy described the impact of mobile tower pollution on local birds[47]. Nyirenda, V.R., Namukonde, N., Lungu, E.B. et al. studied the effects of phone mast-generated electromagnetic radiation gradient on the distribution of terrestrial birds and insects in a savanna protected area[48].Alfonso Balmori, in his article , describes electromagnetic pollution as a possible explanation for the decline of house sparrows in interaction with other factors[49].

Aim of the study

This study aims to examine whether mobile tower radiation has any relevant relationships with the breeding of birds. Many of the above-mentioned studies pointed out the impact of tower radiation on the disappearance of many species of birds from different geographical parts. This paper tries to examine the suspected relation experimentally.

METHODOLOGY

Two methods are used to experimentally find out the relation between the hatching of eggs and the cell tower radiation.

- Hatching Experiment
- Shielding Effectiveness test

The preferred temperature range of birds' egg hatching is between 35 to 40.5°C (84.5 - 104.9°F). The optimum temperature for hen is 37.5 °C. The optimum temperature of some small birds is found to be 35 or 36°C. Above this temperature, the hatch will be reduced. No embryos will survive after 40.5 °C (104.9°F). The specific heat capacity of a material is defined as the energy required to raise the temperature of 1 kg of the material by 1 °C. The specific heat capacity of water is found to be 4200 J/kg°C. That means 4200 Joule is required to raise the temperature of 1 Kg of water by 1 °C. The energy required to raise the temperature of 1 gram of water by 1 °C is 4,2 Joules approximately. We can calculate the time required to raise the temperature of a specific mass with a given power.

$t = \frac{mST}{P}$

t – time required in seconds

m – mass of the substance

S – specific heat capacity

P – the given power

T – temperature difference in °C

Let us examine the power available from a mobile tower at a particular distance. In India, 20 watts antenna is suggested for a cell tower. The table (1) shows the power density at various distances.

P_D - Power Density at a distance R meter

G_T – Gain of the antenna

R - The Distance from the antenna in meters.

P_T = 20 W, G_T = 17 dB = 50

This is for a single carrier, single operator. But the actual case is different. The table (2) shows the power available at various distances, if the number of carriers is 5 and the number of operators sharing the same tower is 5. We can

calculate the time required to raise the temperature of an egg by 1 °C if it is placed 500 meters from a cell tower. Available power density at 500 meters – 4.77 mW/m^2 The mass of an average chicken egg – 50 grams (it contains 80% of water). The energy required to raise the temperature of 1 gram of water by 1 °C is 4,2 Joules approximately.
S – 4.2 J/g°C.
T - 1 °C.
The time required to raise the temperature of the egg by 1°C can be calculated as 12,2 hours. Considering the heat dissipation, and the presents of other materials, it may take 18 hours to raise the egg temperature by1 °C. Considering the average incubation period of 10-18 days it may be a serious threat. Even if a bird incubated its eggs at a distance above 500 meters from a cell tower, the average hatching percentage may be drastically affected by the thermal effect of radiation.

Experimental Method– 1 (Hatching Experiment)
Considered a method to experimentally verify the above theoretical facts. Collected fertilised eggs of some birds which are easily available in abundance. Fifty percent of them are exposed to a radiation power density of 10mW/m^2 for 10 days. Other eggs are stored separately in unexposed conditions. Incubated them together artificially and compare the hatching percentages. Repeated the experiment three times and the average value is taken into consideration. Experiment with two places in India (Chalakkudi, Rajapalayam) and two places in Finland(Tampere, Porvoo).

RESULT AND DISCUSSIONS

Collected fertilized eggs of four birds - Chicken, duck, quail, and crow. Repeated three times at three locations. Table (3) shows the results at Rajapalayam, table (4) shows that of Chalakkudi, and table (5) describes the experiment at Tampere and Porvoo. The average value of three rounds is taken into consideration. We cannot find any relevant relationships between the hatching percentage and the radiation exposure in the case of chicken and duck. But in the case of quail and crow, our observation is that the radiation exposure reduces the percentage of hatching seriously. It can also be observed that quail and crow have lesser egg shell thickness compared to chicken and duck. This may allow more radiation to penetrate inside the shell.

Experimental Method – 2 (Shielding Effectiveness test)
For the previous hatching experiment, a large quantity of eggs is required to produce exact results. But it is very difficult to collect the eggs of wild birds in larger quantities. Moreover, it may badly affect many species. To bypass the above difficulties, we tried another method that never affect their lives.

Shielding Effectiveness (SE)
Shielding Effectiveness is the degree of isolation provided by an enclosure from electromagnetic radiation.

$$SE = 10log\left(\frac{P_0}{P_1}\right)$$

P_0 - Power density measured without the enclosure
P_1 - Power density measured with the enclosure
There are several factors like frequency, polarisation, the thickness of the enclosure, hole dimensions, material permittivity, permeability, and conductivity, which can affect the shielding Effectiveness.. It is usually expressed in dB. The attenuation of EM field is mainly due to two different mechanisms.
1. Absorption
2. Reflection

$$SE_A = 20Log_{10}\left|Exp\left(\frac{t}{\delta}\right)\right|$$

$$\delta = \frac{0.066}{\sqrt{f\sigma\mu_r}}$$

$$SE_R = 20Log_{10}\left|\frac{1}{4}\sqrt{\frac{\sigma}{\mu_r f}}\right|$$

where, t – thickness in meters

δ – depth of penetration

σ – conductivity of the material

μ_r – relative permeability

$$SE = SE_A + SE_R$$

Here we tried to find out the shielding effectiveness of eggshells of different kinds of bird species (figure 1). Sixteen species were examined. Collected the broken hatched eggshells from the wild and hatcheries. The experiment contains an anechoic chamber, MECHO's radiation meter, signal generator 9KHz – 3 GHz, 12dBi high gain omni directional SMA male antenna and eggshell samples. Samples were collected from various places in India and Finland.

RESULT AND DISCUSSIONS

From the previous hatching experiment, we can find that the microwave radiation does not affect chicken and duck, but will affect quail and crows. When comparing the SE values (table 6), the first two have values above 10 dB and the other two have values below 10 dB.So we can find out a value of around 10 dB above which all are almost safe (figure 2). Some small birds having a lower eggshell thickness and lesser SE will be in great trouble. Even at a distance of 1 Km from a mobile tower, their eggs are not safe at all. The figure () shows the comparison.

CONCLUSION

Microwave radiation causes serious issues to humans, animals, birds, and other living organisms. In this study, we examined experimentally whether mobile tower radiation has any relevant relationships with the breeding of birds. Two methods are used to find out the relation between the breeding of birds and cell tower radiation. In the first experiment, collected fertilized eggs of four birds - chicken, duck, quail, and crow. Repeated three times at three locations in India and Finland. We cannot find any relevant relationships between the hatching percentage and the radiation exposure in the case of chicken and duck. But in the case of quail and crow, our observation is that the radiation exposure reduces the percentage of hatching seriously. It can also be observed that quail and crow have lesser egg shell thickness compared to chicken and duck. This may allow more radiation to penetrate inside the shell. In the hatching experiment, a large quantity of eggs is required to produce exact results. But it is very difficult to collect the eggs of wild birds in larger quantities. Moreover, it may badly affect many species. To bypass the above difficulties, we tried another method that never affect their lives. we tried to find out the shielding effectiveness of eggshells of different kinds of bird species. Sixteen species were examined. Collected the broken hatched eggshells from the wild and hatcheries. Some small birds having a lower eggshell thickness and lesser SE will be in great trouble. Even at a distance of 1 Km from a mobile tower, their eggs are not safe at all. We conclude that small birds are in great trouble with the current standards of mobile phone technology. But larger birds like chickens, ducks, storks, etc., are comparatively safe. It does not mean that they haven't any problems with the mobile radiation. Our

study aims to examine the relationships of microwave radiation with breeding only. Further studies are required to assess whether the radiation has any impact on other aspects of their lives like migration, navigational abilities, etc.

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Table(1) : Power density variation (single carrier, single operator)

Distance (m)	P_DmW/m^2
1	79600
3	8840
5	3180
10	796
50	31.8
100	8
500	0.318

Table (2) : Power density values (multi carriers, multi operators)

Distance (m)	P_D mW/m^2
1	1194000
3	126000
5	47700
10	11940
50	477
100	119.4
500	4.77

Table (3) : Hatching at Rajapalayam , Chicken :730, Duck : 314, Quail : 314, Crow : 36 Incubating temperature 37.5 degree Celsius.

Bird	Hatching % without RF exposure	Hatching % with RF exposure	Reduction in %
Chicken	73.89	74.01	-0.12
Duck	68.72	64.36	4.36
Quail	83.29	36.42	46.87
Crow	91.30	66.18	25.12

Table (4) : Hatching at Chalakkudi, Chicken : 517, Duck : 314, Quail : 314 Incubating temperature 37.5 degree Celsius.

Bird	Hatching % without RF exposure	Hatching % with RF exposure	Reduction in %
Chicken	83.65	79.18	4.47
Duck	66.13	70.34	-4.21
Quail	72.28	29.91	42.37

Table (5) : Hatching atTampere and Porvoo,Chicken : 1050, Duck : 1050, Quail : 1050, Crow : 60 Incubating temperature 38 degree Celsius.

Bird	Hatching % without RF exposure	Hatching % with RF exposure	Reduction in %
Chicken	91.31	89.39	1.92
Duck	88.06	92.14	-4.08
Quail	78.14	52.19	25.95
Crow	88.19	53.21	34.98

Table (6) : SE comparison of egg shells of various species.

BIRD	SHELL THICKNESS mm	SE dB
Chicken	0.31	10.83
Duck	0.38	12.37
Quail	0.24	7.45
Pigeon	0.26	7.13
Bustards	0.41	12.9
Woodpecker	0.25	8.19
Crow	0.21	6.12
Old world sparrow	0.16	3.69
House sparrow	0.14	4.89

King fisher	0.24	9.08
Myna	0.18	5.29
Honey bird	0.13	3.92
Little cormorant	0.43	16.1
Parrot	0.26	8.16
Stork	0.53	14.85
Great Egret	0.58	20.11

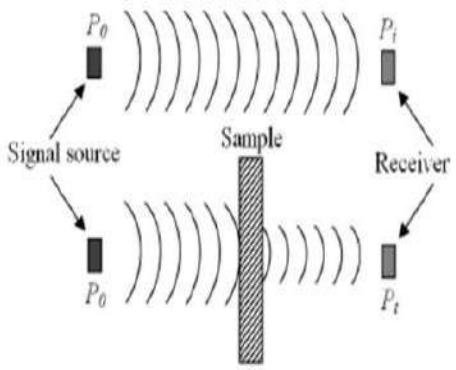
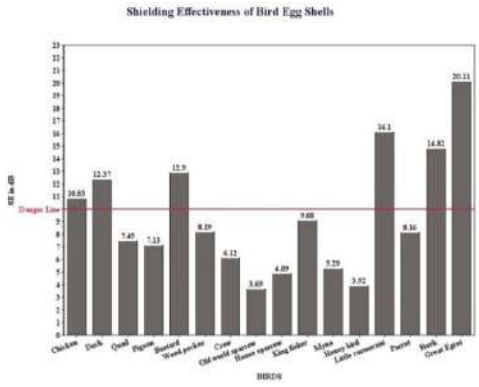


Figure (1): Experimental setup



Figure(2) : SE of different eggshells.

RESEARCH ARTICLE

Bacteriological and Physicochemical Assessment of Effluent from Abattoir in Ibadan Metropolis, Ibadan, Oyo State, Nigeria

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ABSTRACT

Samples were collected from different abattoirs in Ibadan metropolis. Samples were investigated for physicochemical parameters such as pH, temperature, Biological Oxygen Demand (BOD), Dissolved Oxygen (DO), Total Dissolved Solids (TDS), Total Suspended Solids (TSS) and Turbidity using standard techniques and microbiological examination was subsequently carried out using serial dilution where dilutions 2,3,4 were plated in triplicates using the pour plate method on Eosin methylene blue agar and incubated at 37°C for 24 hours. Isolates obtained were then characterized and those confirmed to be *E. coli* were thereafter screened for pathogenicity using Cefixime–tellurite Sorbitol Mac Conkey agar. The pH of the waste water samples were within the range of 6.87–7.46. Temperature values for the waste water also ranged between 27°C–36°C, while turbidity was within 218–J84 FTU. The dissolved oxygen and BOD ranges were within O.85MglL–1.38Mg/L and 1 55Mg/L–298MgIL respectively while the TSS and TDS values ranged between 876Mg/L–1730Mg/L and 163Mg/L–228Mg/L respectively. Bacterial isolates obtained were Gram negative rods, indole positive, motile, methyl red positive, Voges Proskauer negative, citrate negative, catalase positive, with ability to ferment lactose, sucrose, glucose, mannitol, fructose, galactose and were confirmed as *E. coli.* Three isolates out of the forty confirmed *E. coli* isolates using Cefixime–tellurite sorbitol MacConkey were confirmed to be *E. coli* 0157 which amounts to 7.5% of the total *E. coli* isolates obtained from the study. The study suggests that the abattoir waste water could

constitute potential reservoir of pathogenic microorganisms, which can pose health hazards to humans especially when discharged directly into the environment without further treatment.

Keywords: Abattoir**,** *Escherichia coli,* effluent, pathogens, physicochemical parameters**.**

INTRODUCTION

The existing tendency of industrialization, urbanization and increase anthropogenic activities has an enormous impact on natural and man–made environments. Pollution sources increase with the development of cities and caused contamination of air, water, and soil [1]. However, discharge of waste water and other waste into water bodies are the most common pathway for the waste to contaminate drinking and domestic water [2]. The discharged wastewater can contain significant levels of pathogenic bacteria [2]. The contamination of water bodies results in the destruction of primary producers, which in turn leads to an immediate diminishing impact on fish yields, with the resultant consequence of decrease in diet [3]. According to [4,5,6], eutrophication causes many adverse effects on the water bodies including increased biomass of phytoplankton and macrophyte vegetation, increased blooms of gelatinous zooplankton (marine environment), growth of benthic and epiphytic algae, increased toxins from bloom–forming algal species, loss of commercial and sport fisheries, reduced carbon available to food webs, increased taste and odor problems, reduced species diversity, increased treatment costs prior to human use, and decreased aesthetic value of the water body. Abattoirs are generally known all over the world to pollute the environment either directly or indirectly from their various processes [7,8]. Abattoir waste can be seen as waste or waste water from an abattoir which could consist of the pollutants such as condemned organs, carcasses, animal faeces, blood, fat, hides, carcass trimmings, paunch content and urine [9]. Abattoir waste generated as the result of abattoir operations is one of the greatest general environmental threat, this is because they actually pollute all phases of the environment namely land, water and air. Wastes emanating from slaughtered animals are basically in solid and liquid states [10]. According to Nasiru et al. [10], almost each day, in all the urban and rural towns in Nigeria, animals are slaughtered and waste are generated in each day of the week, while the meat and other extracts from the animals are made available to the public for consumption. Osinbajo and Adie [8] reported that most of slaughterhouses disposes their effluents directly into streams and rivers without any form of treatment and the slaughtered meat is washed by the same water. Due to elevated levels of biodegradable organic matter, sufficient alkalinity, and adequate phosphorous, nitrogen and micronutrient concentrations in surface water, a significant environmental and health hazards were reported [6,11,12].

The study by Akanni et al. [13] investigated the effects of indiscriminate disposal of abattoir waste into water bodies in the Aregbe abattoir of Osogboin Osun state, Nigeria. The study examined some physicochemical and bacteriological parameters such as Color, Odor, Temperature, pH, Alkalinity, Turbidity, Total hardness, Appearance, Calcium Hardness, Chlorine ion, Magnesium ion, Dissolved Oxygen and Total Coliform bacteria. Of the parameters observed, only Color, DO and TC exceeded the limits set by the world health organization.In another study, [14] discovered that the concentration ofHardness, Lead (Pb), Copper (Cu), Zinc (Zn), Cadmium (Cd), Iron (Fe) and Faecal coliform exceeded the permissible limits of both the WHO and FEPAstandard for drinking and wastewater effluent. Similar study, analyzed the effect of effluent from abattoir on the quality of adjacent well water in Arowomole, Ogbomosho [15]. The values of parameters tested were reported as follows; pH (6.3–6.7), TS (21.40–26.20mg/l), TSS (18.50 –74.60mg/l), Turbidity (0.3 –6.7NTU), BOD (38.0.2–63.7mg/l), and Conductivity (4.60 – 37.42ms/m) and Nitrate (0.063 – 0.59 mg/l). Faecalcoli form count exceeded the WHO recommended value. Multiple–tube fermentation technique was used to investigate the bacteriological characteristics of abattoir effluents, abattoir water source, and water bodies receiving abattoir wastewater in Abuja, Nigeria[16]. The results revealed that, bacterial counts ranged from 4.8*x*106 to 5.8*x*105 /100mL of total coliform (TC), $8.2x10^4$ to $3.2x10^4$/100mL of Fecal coliform (FC), $5.2x10^4$ to $2.0x10^4$/100mL of *Fecal streptococcus* and $1.2x10^4$ to $2.0x10^3$/100mL of *Escherichia coli* for abattoir effluents $6.6x10^5$ to $6.0x10^5$/100mL of TC, $6.2x10^4$ to $1.8x10^4$/100mL of FC, $1.8x10^4$ to $6.0x10^3$/100mL of *F.*

streptococcus, and $4.8x10^3$ to $6.6x10^2$/100mL of *E. coli* for water bodies receiving abattoir effluents 100m downstream. TC bacteria counts for abattoir effluents exceeded recommended limit for discharge into water bodies in Nigeria. The aim of this research was to assess the impact of abattoir effluent on the quality of surface water in some selected abattoir around Ibadan. The assessment was based on the concentration of physical, chemical as well as bacteriological contents present.

MATERIALS AND METHODS

Location of the study

The samples were collected from different abattoirs located at Onibu Ore, Bodija, Gbagi, Alegongo, Moniya, Ariyo, Babanla, Aleshinloye, Akinyele and Ojoo of Ibadan Metropolis, Ibadan, Oyo State, Nigeria.

Sample collection

All glass wares used in the collection of samples were sterilized in an autoclave at a temperature of 120°C for three hours before the samples of 100 ml and 2 liters of each of the sample were collected for bacteriological and physiochemical analysis respectively [17,18]. Samples were collected in the morning after slaughter had been completed. The samples were collected from different abattoirs located at Onibu Ore, Bodija, Gbagi, Alegongo, Moniya, Ariyo, Babanla, Aleshinloye, Akinyele and Ojoo.

Physicochemical analysis

Physiochemical parameters were measured which include; Color, Odor, pH, Temperature, Total Dissolve Solids (TDS), Chloride (Cl), Dissolved Oxygen, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Solids, Total Suspended Solids, Nitrate, Physical and Chemical parameters were determined by instrumental and standard analytical methods [14,19].

Serial dilution

One milliliter of the abattoir liquid effluent sample was pipetted in to 9ml of sterile distilled water aseptically and labeled 10^{-1}. The obtained solution was used for further dilution up to 10^{-5}[20].

Inoculation of samples:

In duplicates, 1ml of each dilution 10^2,10^3 and $l0^4$ was pipetted into each of the petridishes. Eosine Methylene Blue (EMB) agar was sterilized using the autoclave at 121°C for 15 minutes which was allowed to cool to about 45°C, swirled gently and allowed to set. The plates were incubated at 37°C for 24 hours.

Sub culturing of bacterial colonies:

The suspected *E. coli* colonies obtained from different abattoir effluent samples on EMB agar plates were sub–cultured on nutrient agar plates and incubated at 37°C for 24 hours and subsequently subcultured until pure cultures were obtained. The pure culture was subcultured on nutrient agar slants and incubated at 37°C for 24 hours and subsequently used for biochemical tests [20].

Gram's staining:

A drop of normal saline was placed on the centre of a clean grease–free slide and a loopful of the isolate was emulsified, making a thin smear on the slide. The smear was air–dried and heat–fixed by passing it over flame so that the organism will not be washed off during the staining process. Few drops of crystal violet were added to the smear and allowed to stay for about 60 seconds, then rinsed off by placing the slide under running tap. Gram's iodine was added as mordant to fix the crystal violet stain; it was rinsed off after 60 seconds. The slide was flooded with 70% ethanol to serve as decolorizer, allowed to stay for about 20 seconds and washed off with water. Safranin was added as counter stain; it was left to stay for 60 seconds and rinsed off. The slide was allowed to air dry. A drop

of immersion oil was added. The color of the organism and shape of the cells in the smear were observed using a light microscope with oil immersion objective lens [20].

Biochemical test

The biochemical tests were used to determine the ability of the organism to produce Indole test, Methyl Red test, Voges Proskauer test, Catalase test, Citrate Utilization test, Hydrolysis of urea, Nitrate reduction test for identification [20,21].

Serological test

he bacterial samples were tested for serological reaction. The isolates were tested with antisera latex reagent placed directly on the plates. The positive samples *E. coli* 0157showedagglutination, while the negative samples indicated non agglutination on the plate [21].

RESULTS AND DISCUSSION

The results of the physiochemical and biochemical analyses are presented in Table 1, 2, 3 and 4. Table 1 showed the results of the physicochemical analysis on abattoir still effluent samples obtained from different locations within Ibadan Metropolis. The pH values were in the range of 6.87–7.46 with the highest pH value of 7.46 recorded in Akinyele abattoir followed by effluent from Aleshinloye with a pH value of 7.39. The pH of 7.39 from Aleshinloye is closely followed by samples from Gbagi and Ariyo with pH values of 7.38. The finding of this work agreed with [22] who reported that abattoir waste water was slightly alkaline, however, there is a slight shift from a study who reported the pH of abattoir waste water was acidic, ranging from 4.3 to 5. A pH near 7.0 (neutral) played a part in determining, both the qualitative and quantitative abundance of microfolora [23]. The temperature of the samples collected was within the range of 29–36°C with the highest temperature recorded at Akinyele abattoir. Bodija abattoir had the highest turbidity value (384FTU) with Akinyele abattoir following closely at 379FTU and the lowest value was recorded at Akobo abattoir. The BOD values obtained were very high within the range of 155–298. The highest BOD value was observed in Akinyele abattoir (298Mg/L) with the abattoir at Bodija having BOD value of 294Mg/L. The lowest BOD value was obtained in Babanla abattoir. The highest value for total suspended solids (TSS) and total dissolved solids (TDS) was also recorded at Akinyele abattoir and the lowest value for TSS was observed at Akobo abattoir. The lowest dissolved oxygen value was observed in Ojoo abattoir (0.85Mg/L) while abattoir located at Aleshinloye had the highest value of 1.38Mg/L.

The results of the microbiological evaluation revealed varying microbial load in the range of 1.0 x 10^3cfu/ml–4.2 x 10^3cfu/ml. The varying microbial load can be attributed to the number of animals slaughtered in the abattoir per day and also the rate of human activities as well as the sanitary conditions present in such abattoir [24]. Going by international standards of 2.2/100ml, any water contaminated to this level is neither good for domestic use nor is supposed to be discharged directly into the environment without treatment. The high microbial content of the waste water is also an indication that the water used during the processing of beef in abattoir is not sterile or fit for consumption [25]. From this study, high prevalence of *E. coli* was observed as it was isolated at every site and in all samples cultured giving a 100% occurrence. Nkanga and Uriah [26] reported high prevalence rate of *E. coli* in raw meat samples from abattoir and traditional open markets, with a prevalence rate of 85.65%. The presence of these organisms in abattoir facilities depicts a deplorable state of poor hygienic and sanitary practices employed in the slaughtering, processing and packaging of fresh meats. This agrees to previous reports by [27]. The presence of *E. coli* in the waste water effluents is an indication of faecal contamination of the meat and might be due to, possible contamination of fresh meats or meat products itself during slaughtering or beef processing or unhygienic handling of the meat right from the slaughtering, butchering plants or due to contamination from the skin, mouth of the handlers [28]. The microbial analyses of the waste water and receiving surface water showed that the mean total bacteria and total coliform counts exceeded [29,30] recommended value. A similar study carried out by [31] on the surface water revealed that the

total bacteria (cfu/ml) and *E. coli* counts/100ml exceeded the recommended limits hence making this source of water unfit for meat processing. These serve as legible indicators of the extent of the pollution of the water body used for meat processing at the abattoir. In this study, 30% of the abattoirs from which abattoir effluents were taken had the presence of *E. coli* 0157. Enterohaemorrhagic *E. coli* is a recent emerging group of food borne pathogens. Since 1982, EHEC strains have caused worldwide outbreaks of haemorrhagic colitis which have led 10% of the cases to life threatening haemolytic–uremic syndrome [32]. *E. coli* of serotype 0157:H7 is the leading cause of EHEC infections in humans [33]. A wide range of animals are known to carry STEC and EHEC strains, but ruminants are the most important natural reservoir and they excrete these bacteria with their faeces [32]. Differences may arise because of methodology, season, cleanliness and transport–associated stress prior to slaughter. Although the main infection routes are person to person transmission, as well as consumption of contaminated meat and milk, ingestion of contaminated vegetables or water and direct contact with animals or soil have been associated with EHEC associated outbreaks [33]. Land application of sludge and effluent discharge in surface water contribute to the spread of EHEC in the environment. Contamination of the environment, followed by uptake of EHEC by farm animals on pasture, maintains the epidemiological cycle of EHEC and is a public health concern [33]. The abattoir has been identified as a major link in the transmission of *E. coli* 0157 to the food chain and cross–contamination of the carcass with faeces [34] and cattle and other ruminants have been established as major natural reservoirs for *E. coli* 0157 [35]. Foods contaminated with enteropathogenic bacteria are an important factor contributing to the high incidence of diarrhoea in developing countries [36]. Pathogenic *E. coli* remain a potential threat to human health with beef, broiler chickens, and pork serving as possible sources of these organisms in the environment [37].

In Nigeria, where abattoir operations are rudimentary, the risks of pathogen contamination are higher, because in modern industrial abattoirs, a spillage from guts onto the meat during evisceration rarely occurs and contamination of carcass meat almost always results from the hide [38]. The presence of *E. coli* 0157 strains in both waste water and receiving water body as well as other pathogens (especially the Enterobacteriaceae, many of which are associated with gastroenteritis in humans) indicate the need for waste water treatment before discharge into water bodies after complying with international limits. The reported relatively high prevalence of *E coli* 0157 strains (8%) from the waste water in this study poses a major concern as other studies by various authors in Nigeria, reported low prevalence of 0.5 –2% [39].

Results obtained in the physiological studies showed that *E. coli* 0157 isolates gave best growth rates at 37°C, a temperature of incubation recommended by [40]. *E. coli* is a typical mesophile growing from 7°C–10°C up to 50°C with an optimum around 37°C. According to Bergey's Manual [41], the optimal temperature of *E. coli* is 36°C–37°C, though growth occurs over a fairly wide temperature range (18– 44°C). In this study, the growth rate of *E. coli at* 25°C and 30°C was less than 37°C, whereas 45°C gave the lowest growth rate. This may be due to *E. coli* being a mesophilic bacterium [41]. Similar results were reported by [42] although 32°C and 42°Care symmetric around the temperature 37°C at which *E. coli* had been propagated, relative to 37°C, 42°C reduces both maximal growth rate and yield, whereas 32°C reduces only the former. The temperature 42°C is approximately 0.5°C off the critical thermal limit for extinction of the bacterial population under standard culture conditions, whereas 32°C is more than 10 °C away from both the upper and lower thermal limits. Whereas 42°C induces expression of stress proteins that mediate a protective response, 32°C does not. Raina *et al.* [43] reported that in *E. coli* the classical heat shock response appears as a transient acceleration in the synthesis of 20 proteins.

Physiological studies on the pathogenic organisms revealed that the organisms grow best at neutral pH, using glucose as sole carbon source and in the absence of glucose, can also use lactose; however, there is significant difference between effect of maltose and mannitol on growth of the organisms, both organic and nitrogen sources have almost the same effect on the growth of the organisms with no significant difference at 95% confidence interval. The organisms show almost the same growth patterns when different salts were tested with no significant difference. 30% of the abattoirs samples obtained had the presence of pathogenic organisms whereas *E. coli* was present in all samples analysed which is an indication that the practices in these abattoirs need to be improved upon and effective

waste water treatment need to be introduced into the abattoirs so as to curb the menace of EHEC associated diseases in the society as a result of environmental pollution.

CONCLUSION

This study provides an initial baseline data on the occurrence of *E. coli* 0157 in abattoirs within Ibadan Metropolis of South Western Nigeria. The findings of this study mean that a number of measures need to be taken to lessen the risk of transmitting *E. coli 0157* along the meat chain from farm to fork. The practices in the abattoirs are not in tandem with best practices worldwide and measures must be put in place that can reduce these risks. These include good animal husbandry, pre–skinning decontamination as well as incorporation of hazard analysis and critical control points (HACCP) in the abattoirs.

CONFLICT OF INTEREST

There exists no conflict of interest amongst authors regarding publication of this manuscript.

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Table 1: Physicochemical analysis of still abattoir effluent samples from within Ibadan Metropolis.

Location	pH	Temperature (^{0}C)	Turbidity (FTU)	DO (Mg/L)	BOD (Mg/l)	TSS (Mg/L)	TDS (Mg/L)
Onibu Ore	7.18	27	314	0.99	210	890	205
Bodija	7.22	27.8	384	1.23	294	1100	217
Gbagi	7.38	30	265	1.35	231	935	202
Ojoo	7.16	26.5	293	0.85	189	930	163
Akobo	6.87	29	218	1.27	205	876	188
Babanla	7.29	34	319	1.22	155	897	205
Ariyo	7.38	28	274	0.85	162	1070	192
Aleshinloye	7.39	34	256	1.38	193	985	174
Akinyele	7.46	36	379	0.95	298	1730	391
Moniya	7.14	29.5	327	1.34	215	1150	228

*Values are means of two replicates

Table 2: Total *Escherichia coli* counts from abattoir still effluent samples from within Ibadan Metropolis

Location	Sample code	Average CFU/ML
Onibu ore	A	3.0×10^3
Bodija	B	1.8×10^3
Gbagi	C	1.4×10^3
Ojoo	D	1.8×10^3
Akobo	E	1.7×10^3
Babanla	F	1.2×10^3
Ariyo	G	1.0×10^3
Aleshinloye	H	3.6×10^3
Moriya	I	1.5×10^3
Akinyele	J	2.8×10^3

Table. 3: Biochemical Characterization of bacterial isolates obtained from abattoir still effluent samples within Ibadan Metropolis

Isolate	Gram Staining	Shape	Nitrate	Citrate	Catalase	MR	VP	Indole	Urease	Probable Organism
A11	–	Rods	+	–	+	+	–	+	–	*E. coli*
A12	–	Rods	+	–	+	+	–	+	–	*E. coli*
A21	–	Rods	+	–	+	+	–	+	–	*E. coil*
A22	–	Rods	+	–	+	+	–	+	–	*E. coli*
B21	–	Rods	+	–	+	+	–	+	–	*E.coli*
B22	–	Rods	+	–	+	+	–	+	–	*E.coil*
B23	–	Rods	+	–	+	+	–	+	–	*E.coli*
C1	–	Rods	+	–	+	+	–	+	–	*E.coli*
C21	–	Rods	+	–	+	+	–	+	–	*E.coli*
C22	–	Rods	+	–	+	+	–	+	–	*E.coli*
D11	–	Rods	+	–	+	+	–	+	–	*E.coli*
D12	–	Rods	+	–	+	+	–	+	–	*E.coli*
F11	–	Rods	+	–	+	+	–	+	–	*E.coli*
F12	–	Rods	+	–	+	+	–	+	–	*E.coli*
F21	–	Rods	+	–	+	+	–	+	–	*E.coli*
F22	–	Rods	+	–	+	+	–	+	–	*E.coli*
F21	–	Rods	+	–	+	+	–	+	–	*E.coli*
F22	–	Rods	+	–	+	+	–	+	–	*E.coli*
F31	–	Rods	+	–	+	+	–	+	–	*E.coli*
F32	–	Rods	+	–	+	+	–	+	–	*E.coli*
F41	–	Rods	+	–	+	+	–	+	–	*E.coli*
G31	–	Rods	+	–	+	+	–	+	–	*E.coli*
G32	–	Rods	+	–	+	+	–	+	–	*E.coli*
G41	–	Rods	+	–	+	+	–	+	–	*E.coli*
G42	–	Rods	+	–	+	+	–	+	–	*E.coli*
H31	–	Rods	+	–	+	+	–	+	–	*E.coli*
H32	–	Rods	+	–	+	+	–	+	–	*E.coli*
H41	–	Rods	+	–	+	+	–	+	–	*E.coli*
H42	–	Rods	+	–	+	+	–	+	–	*E.coli*
141	–	Rods	+	–	+	+	–	+	–	*E.coli*
142	–	Rods	+	–	+	+	–	+	–	*E.coli*
J21	–	Rods	+	–	+	+	–	+	–	*E.coli*
J22	–	Rods	+	–	+	+	–	+	–	*E.coli*
J31	–	Rods	+	–	+	+	–	+	–	*E.coli*
J32	–	Rods	+	–	+	+	–	+	–	*E.coli*
K21	–	Rods	+	–	+	+	–	+	–	*E.coli*
K22	–	Rods	+	–	+	+	–	+	–	*E.coli*
K32	–	Rods	+	–	+	+	–	+	–	*E.coli*
K41	–	Rods	+	–	+	+	–	+	–	*E.coli*

Table 4: Prevalence of *E. coli* and *E.coli*0157 in abattoir still effluent samples within Ibadan Metropolis.

No of samples Analysed	No. with *E.coli*	%	No. with *E.coli* 0157	No E. coli Isolates	No. identified as *E.coli* 0157	%
10	10	100	3	40	3	7.5

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RESEARCH ARTICLE

Rudimentary Tongue Tie-A Challenge to the Periodontist

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ABSTRACT

Tongue as an orofacial structure in the oral cavity plays a very important role in eliciting a variety of functions which includes clarity of speech, nursing, maintenance of oral hygiene and swallowing. Ankyloglossia is a congenital deformity which is characterised by the presence open abnormally short and thick lingual frenum which untowardly affects the movement of the tongue. In this case elaborated below a 28-year-old patient reported with a rudimentary tongue tie and complaint of communication gap due to slurred speech. Treatment protocol followed in this particular case was frenectomy with muscle repositioning procedure.

Keywords: Ankyloglossia, orofacial, tongue tie, lingual frenum, rudimentary tongue tie.

INTRODUCTION

Ankyloglossia also known as sometime is a congenital deformity which is characterised by the presence of a short lingual frenum. The major concern associated with tongue tie is the condition being asymptomatic. The infant or adolescent and adult may present with several factors such as difficulty in breast feeding and impaired speech. There can be problems associated with articulating explosive words such as l,t,r,d. The person may also present with

difficulties in licking ice cream, play wind instruments such as trumpet flutes and orthodontically related problems such as open bite. The individual may also present with low self-esteem and confidence. The individual may face communication gap with his family and friends. The individual may also present with isolation and anxiety. Such individuals may also face obstacles in finding job opportunities as at some point they require articulation and expression of one's ideas with confidence. Search individuals may also face issues such as bullying and ragging[1,4].
Different classifications associated with ankyloglossia may include 1:Kotlow's Classification [2]. Type of movement of tongue which is clinically acceptable the normal range of free tongue movement should be greater than 16 mm.Class1 mild ankyloglossia 12 to 16.Class 2 moderate ankyloglossia 8 to 11 mm. Class 3 severe ankyloglossia 3 to7 mm. Class 4 complete ankyloglossia less than 3. Ankyloglossia can be associated with other syndromes namely; the Pierre Robin Syndrome, the Oral -Facial -Syndrome, Meckel'ssyndrome, Down's syndrome, the Robinow syndrome, the Short rib syndrome, the ATR-X Syndrome, Fraser's Syndrome, the Wiedemann -Beckwith syndrome, Van der Woude's syndrome and Glossopalatine syndrome. Various treatment modalities include surgical or non-surgical approaches. surgical modalities include frenotomy, frenectomy and frenuloplasty [5]. These interventions involve undermining or incision of the lingual frenum. Laser frenectomy or frenotomy has also been described and proponents argue that its use is more exact and provides better haemostasis than standard frenectomy or frenotomy. Frenuloplasty, more technically involved than frenotomy or frenectomy ,generally refers to rearranging tissue or adding grafts after making incisions and closing the resultant wound in a specific pattern to lengthen the anterior tongue [3,4].

Case Report
Patient 28 years old reported to the Department of Periodontology with a chief complaint of slurring and impaired speech. Patient further complaint about pronouncing explosive words such as L, R, T, D. patient complaint about low self confidence and self-esteem while conversing. Patient stated his medical history that he suffered an epileptic seizure when he was five years old. The patient did not complain of any episode thereafter. The patient was asthenic built. He walked to the Periodontology OPD with a normal gait, there was no disability observed. The patient was well aware of time, place and person. The vitals of the patient were normal.

ENT Consultation-
Laryngoscopy Findings suggested normal bilateral aryepiglottic fold. Normal bilateral mobile vocal cords. Adequate Glottic Chink. Normal palatal movement. Normal Palate.

Speech Therapy Consultation
wherein the speech therapy was initiated 2 weeks prior to the surgery. There were a few exercises which were advised which included Retraction- Hold the smile for 10 seconds. Relax and repeat. Put pressure on lip by pressing them together for 5 seconds. Relax and repeat. Fill the cheeks with air and hold for 15 seconds. Tongue –Stick out the tongue as far as you can and hold for 5 seconds and relax. Depress the tongue downwards and put force in opposite direction. Lip Protrusion-Make a pout, hold for 5 seconds. Straw –Blow in a straw after taking deep breath. Blow air on the candle by keeping it at 2 different distances. Repeat after 3 times. Breathing –Abdominal breathing. Practice for 10 times.

Extra-Oral examination-
The face of the patient was bilaterally symmetrical. On TMJ examination, the interincisal opening was 35 mm, there was no deviation observed. There was no clicking or popping sound produced, patient did not complain of any pain on opening or closing of the mouth. There was no crepitus present. The lymph nodes were non tender and non-palpable on examination. There was no complaint of nasal obstruction, discharge or any history of persistent bleeding. The patient did not complain of any specific visual disturbances ocular pain or oedema of the eyelid. There was no history of impaired hearing, loss of hearing, discharge from ears or tinnitus. There was no obstruction in movement of the neck, there was no enlargement which was absorbed.

Intraoral findings

Volume of the tongue was normal, the distribution of papilla observed for normal. The appearance of the tongue was heart shaped or v shape. No lateralisation was present. Elasticity of the freedom was little or non-elastic. Lift of the tongue tie stays at the lower alveolar Ridge or rises mid mouth only with job closure. Length of lingual frenum when tongue is lifted is less than 1 cm. Extension of the tongue tip over the lower gums only. Attachment of the lingual frenum to the tongue is neither or above or anterior or mid tongue humps. Attachment of the lingual frenum to the tongue-notched tip. Spread of the anterior tongue is little or none. Attachment of lingual frenulum to the inferior alveolar ridge is attached to the floor of the mouth or well below the ridge. Poor cupping was observed. Peristalsis was complete which was anterior or posterior. The shape of the palate was U shaped. The lips were potentially competent. There was no abnormality observed in the floor of the mouth, buccal mucosa and labial mucosa. There was Angles' Class I Dewey's Type II malocclusion was observed.

Diagnosis

The patient was diagnosed on the basis of MRI Scan, Complete Hemogram, Liver function test, Urine analysis, ENT therapy and Speech therapy. Relevance of performing MRI Scan was to rule out any chances of any brain lesions or syndromes which could be associated with tongue tie. The scan also helped us to determine the safety of the procedure which was to be performed that is there should not breach any of the underlying important nerves. The Complete hemogram was done as a safety intervention to be performed before every surgery. The liver and urine analysis were performed, as it is a pre-requisite to be done prior the insertion of the contrasting dye done before the MRI Scan. The ENT analysis was done to rule out the cause of speech deformity due to an abnormal palate, inadequate palate movement to produce certain phonetics or the presence of any immobile vocal cords through laryngoscopy. The speech therapy was done in order to help the patients to achieve clarity of speech while working in conjunction of the interventional surgical procedure.

Assessment

MRI Scan -The reports were normal. There are no relevant findings. The MRI Scans of the patient were normal. No relevant radiographical findings were observed. The consultant neurologist further concluded that ipsilateral lingual nerve palsy in this case even if a possibility is extremely rare.

Surgical intervention

The patient was advised surgical intervention which include the frenectomy with respect to the lingual frenum along with the muscle repositioning which would help in the mobilisation of the tongue. The patient was further explained that the surgery might not lead to the clarity of the words which created a hindrance in speaking for the patient before. The patient was further explained that speech therapy is more beneficial at a younger age because as we age, we develop a certain was of producing the required phonetics. The patient was briefed about the required procedure and with his consent the surgical intervention was proceeded.

Procedure

Antibiotic prophylaxis was given before the procedure. Extra-oral and intra-oral antisepsis was done with 5% povidone-iodine solution. Lingual nerve block was achieved using 2% lidocaine hydrochloride with 1:80,000 adrenaline and local infiltration in the frenum was done. To attain tongue traction 3-0 silk suture was passed through the dorsum of the tongue. Two curved artery forceps were placed over the upper and lower attachments of the frenum. For incising the triangular tissue of frenum a 980 nm diode laser was used in contact mode with a power setting of 3 Watts. Protective eyewear was worn by both the operators and the patient while operating with lasers. Tip of the Optical fibre was used to remove the tissue from apex to the base of frenum and to excise the alveolar attachment. The surgical field was wiped with wet gauze to prevent excess thermal damage. The remaining fibres were excised using number 15 blade. Genioglossus muscle was bluntly dissected with dissecting scissors. The tongue was mobilized during the procedure to check for movements of tongue. Epithelium was sutured using 3-0 silk sutures for approximation. Post-operative instructions were given. Amoxicillin and Zerodol P were prescribed twice a day for 3 days. Patient was recalled after 10 days for suture removal.

DISCUSSION

The incidence rate of ankyloglossia ranges from 0.1%-10 %. The prevalence rate in males to females is present in the ratio of 24:12. The prevalence rate seen in individuals of varying ethnic origin are Hispanic 18%, White 8%, Pacific Islander 5%, Asian 4% and American -African 1 %. Tongue tie is the most commonly found in infants when there is a problem in breastfeeding for the infant.[4]The tongue plays an important role in nursing. It helps to pull the breast to a position where it is easy for the infant, as it grooves along its length to make a channel to keep the breast in place in the mouth and to catch the milk and to hold it at the back of the tongue in preparation for swallowing. The back of the tongue drops to the floor of the mouth, the milk is expelled from the breast by the combination of positive and negative pressure. Hence the immobility of tongue interferes with the latching on to the mammary gland. This further causes fatigue to the infant leading to frustration and low weight seen among infants due to lack of proper nutrition. Other maternal symptoms included are sore nipples and mastitis. When ankyloglossia persists well in adolescence and adulthood, the issues related to oral hygiene maintenance, speech problems and psychological inadequacies. The tongue serves as an important orofacial structure which helps in maintaining oral hygiene especially in the lingual aspect of the mandibular anterior. Lingual mobility further causes messy eating habits, incorrect position of the tongue while swallowing. The food debris remaining on the teeth and lips further leads to rampant tooth decay. In some cases, orthodontic problems such as malocclusion can be seen due to inadequate mandibular development. Our tongue plays a significant role in oral stereognosis that helps in the perception of different shapes and objects. It also helps in detecting harmful objects within food such as uncooked pieces of rice. Interdental clogging of fibrous food can be detected and removed by the tongue. Due to restriction of the lateral movement of the tongue, oral hygiene as well as protection is hampered. It plays a crucial role in expressing human emotion and a variety of social activities. Due to restriction in protrusion, elevation and rotation of the tongue, licking of ice cream or playing wind instruments becomes a difficult task [5].

CONCLUSION

The diagnosis of tongue tie is based on medical record of the patient and the clinical examination, The presence of AG may be either asymptomatic or leading in several complications. It is upon the clinician to select a treatment plan according to age, degree of difficulty of the case and the approach that he wants to use regarding a specific case. The cases of ankyloglossia pose a great difficulty to the clinician in terms of being multifactorial, however it is done with the use of the latest technology can yield exemplary results. Post the surgical intervention in the given case, the patient felt immense increase in his self-esteem and confidence while speaking. As a clinician the happiness and satisfaction of the patient always remains our topmost priority.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Appearance	Function
Appearance of tongue when lifted	Lateralization
2: Round or square	2: Complete
1: Slight cleft in tip apparent	1: Body or tongue but no tongue tip
0: Heart or V-shaped	0: None
Elasticity of frenulum	Lift of tongue
2: Very elastic	2: Tip to mid-mouth
1: Moderately elastic	1: Only edges to mid-mouth
0: Little or no elasticity	0: Tip stays at lower alveolar ridge or rises to mid-mouth only with jaw closure
Length of lingual frenulum when tongue lifted	Extension of tongue
2: >1 cm	2: Tip over lower lip
1: 1 cm	1: Tip over lower gum only
0: <1 cm	0: Neither of the above, or anterior or mid-tongue humps
Attachment of lingual frenulum to tongue	Spread of anterior tongue
2: Posterior to tip	2: Complete
1: At tip	1: Moderate of partial
0: Notched tip	0: Little or none
Attachment of lingual frenulum to inferior alveolar ridge	Cupping
2: Attached to floor of mouth or well below ridge	2: Entire edge, firm cup
1: Attached just below ridge	1: Side edges only, moderate cup
0: Attached at ridge	0: Poor or no cup
	Peristalsis
	2: Complete, anterior or posterior
	1: Partial, originating posterior to tip
	0: None or reverse

14 = Perfect score. 11 = Acceptable if appearance item score is 10. Frenectomy is necessary if function score is <11 and appearance score is <8.

Table 1. Hazel baker's assessment tools for appearance and function of the tongue [2]

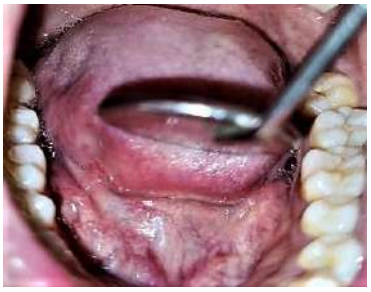

Fig 1. Pre –Operative Photograph- In normal cases of ankyloglossia, lingual frenum is prominent. Note the non-existent lingual frenum.

Fig 2. Classical method of isolation of the surgical side using two haemostats in a triangular pattern

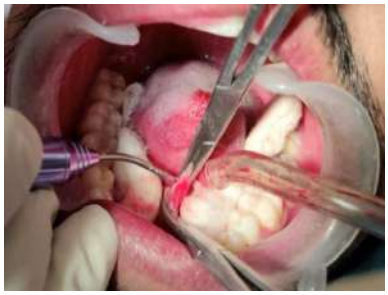

Fig. 3. Diode Laser used at 980nm at a power of 3 watts in continuous contact mode for the incision of the isolated lingual frenum. Use of laser helps in maintaining a bloodless field.

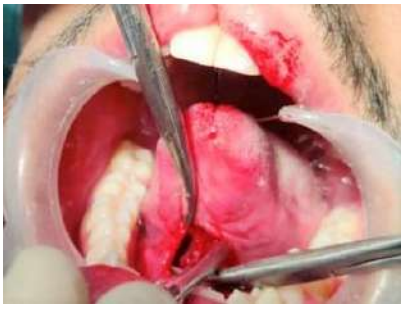

Fig.4. Submucosal Plane of Dissection was included in all directions, mobilising the underlying genioglossus muscle.

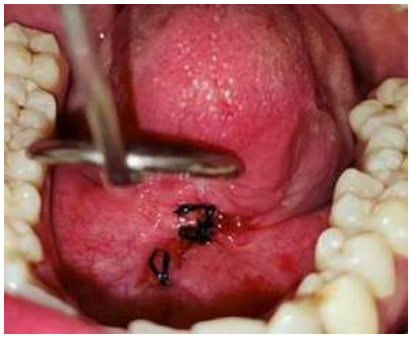	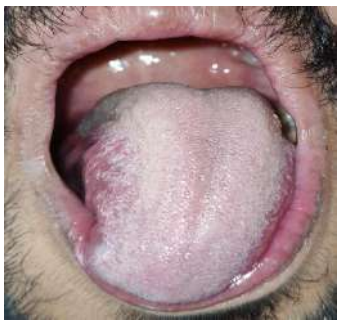
Fig 5. Final Sutures are given at the Surgical Site using Vicryl 4-0 Sutures in interrupted pattern.	**Fig6. Considerable difference seen in the protrusion of the tongue.**

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RESEARCH ARTICLE

Mathematical Model for Coronavirus Disease 2019 Containing Isolation Class

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ABSTRACT

The epidemic outbreak caused by corona virus COVID-19 is of great interest to researches because of the high rate of the infection spread and the significant number of fatalities. Long-time predictions require complicated mathematical models that need a lot of effort to identify and calculate unknown parameters. In this study we use the known SIR model for the dynamics of an epidemic, the known exact solution of the linear differential equations developed before for investigation of the covid cases of Tamil nadu.

Keywords: Corona virus epidemic, COVID-19 in Tamil nadu ; Mathematical modeling of infection diseases; SIR model; parameter identification; Runge -Kutta fourth order method.

INTRODUCTION

We develop a mathematical model to present the dynamical behavior of COVID-19 infection by incorporating isolation class. First, the formulation of model is proposed; then, positivity of the model is discussed. The local stability and global stability of proposed model are presented, which depended on the basic reproductive. For the numerical solution of the proposed model, the nonstandard finite difference (NSFD) scheme and Runge-Kutta fourth order method are used. Finally, some graphical results are presented. Our findings show that human to human contact is the potential cause of outbreaks of COVID-19. Therefore, isolation of the infected human overall can reduce the risk of future COVID-19 spread. The optimal values of the SIR model parameters were identified with the use of differential equations. The numbers of infected, susceptible, exposed and recovered persons versus time were predicted and compared with the new data obtained after March 25th 2020. Here, we consider the development of an

epidemic outbreak caused by corona virus COVID-19 Since long-term data are available only for main-land China. For long-time predictions, more complicated mathematical models are necessary. For example, a susceptible-exposed-infectious-recovered (SEIR) model was used. For the para-meter identification, we will use the exact solution of the SIR set of linear equations . The study emphasizes on the first case of the COVID – 19 pandemic in the Indian state of Tamil nadu reported on 7 March 2020. The largest single-day spike (30,987 cases) was reported on 13 May 2021 and Tamil Nadu now has the fourth highest number of confirmed cases in India after Maharashtra, Kerala and Karnataka. All 38 districts of the state are affected by the pandemic, with capital district Chennai being the worst affected. As per the Health Department, 88% of the patients are asymptomatic while 84% of deaths were among those with co-morbidities. In June, the state saw a surge in deaths with 209 deaths (36% of the state's recorded deaths) occurring between 11 and 16 June, 2020. The initial surge in cases in the state was due to a cluster linked to a Tablighi Jamaat religious congregation event that took place in Delhi, which caused a spike in early April. Another large local cluster in Koyambedu of Chennai was identified in May 2020.

The state government has responded to the outbreak by following a contact-tracing, testing and surveillance model. The state has 85 laboratories approved by Indian Council of Medical Research (ICMR), capable of conducting tests. The state has been under a lockdown since 25 March which was relaxed to an extent from 4 May onwards. The lockdown was further extended until 30 June with significant relaxations from 1 June 2020. The state has enforced a stricter lockdown in four majorly-affected districts which includes Chennai and its three neighbouring districts of Chengalpattu, Thiruvallur and Kancheepuram from 19 to 30 June 2020. Researchers have been tracking the spread of the virus, have mobilized to speed innovative diagnostics, and are working on a number of vaccines to protect against COVID-19. Cao et al. [1, 2] studied the clinical features of corona virus and discussed the short-term outcomes of 18 patients and 102 patients with COVID-19 in intensive care units. For the demographic details of 102 patients, see Table 1 [2]. Corona viruses are typically transmitted from person to person through respiratory droplets and close contact. The majority of the transmission is happening through respiratory droplets that we may inhale from close contact with one another [3]. A modified SIR epidemic model is presented in [3] to project the actual number of infected cases and the specific burdens on isolation wards and intensive care units. Nesteruk [7] developed an SIR (Susceptible, Infected, and Recovered) epidemic model and discussed statistically the parameters used in the proposed model and -showed how to control this infection. Unfortunately, the number of corona virus victims is expected to be much higher than that predicted on February 10, 2020, since 12289 new cases (not previously included in official counts) have been added two days later. Further research should focus on updating the predictions with the use of up-to-date data and using more complicated mathematical models. Currently, there are no licensed vaccines or therapeutic agents for corona virus prevention or treatment though research studies into potential antiviral and vaccine candidates are underway in a number of countries. Vaccine testing, development, and distribution are typically a much longer process than drug development, and it is not likely that a vaccine for COVID-19 will be ready before 2021 at the earliest. The virus can easily spread in dense places. Social distancing or low contact rate refers to measures that are taken to increase the physical space between people to slow down the spread of the virus. Batista [5] studied the logistic growth regression model which is used for the estimation of the final size of the corona virus epidemic. Several researchers developed different models of COVID-19 and studied dynamical behavior (see for instance [3,5-7]).

From the above discussion, it was concluded that human to human contact is the potential cause of outbreaks of COVID-19. Therefore, isolation of the infected human overall can reduce the risk of future COVID-19 spread. In order to do this, we divided the total population into five compartments: susceptible, exposed, infected, isolated, and recovered from the disease. This study will lead to the mathematical model formulation in which the interaction of the exposed population and infected population occurred to the susceptible populations. The infected individuals, the individuals showing no symptoms apparently but have the disease in weak form inside their bodies, must be sent to isolated classes at different rates. The local stability and global stability of the model is discussed, by using the approach of the basic reproduction. For the numerical solution of the proposed model, the nonstandard finite difference (NSFD) scheme and Runge-Kutta fourth order method are used. Finally, some graphical results are presented. Our findings show that human to human contact is the potential cause of outbreaks of COVID-19. Plots

present the susceptible, exposed, infected, isolated, and recovered population when $\Re_0 > 1$ The paper is organized as follows: Section 2 is related to the model formulation keeping in mind the assumptions that exposed and infected individuals are making contacts with susceptible individuals at the same rate. Section 3 is concerned with the local stability and existence of positive equilibrium solution. Some numerical simulations are executed to illustrate the analytical results in Section 4. Finally, conclusions are presented in Section 5.

Model Formulation

In this section, we develop the mathematical model by taking into account the above assumptions.

$$\begin{cases} \frac{dS(t)}{dt} = A - \mu S(t) - \beta(N)S(t)E(t) + I(t), \\ \frac{dE(t)}{dt} = \beta(N)S(t)E(t) + I(t) - \pi E(t) - (\mu + \gamma)E(t), \\ \frac{dI(t)}{dt} = \pi E(t) - \sigma I(t) - \mu I(t), \\ \frac{dQ(t)}{dt} = \gamma E(t) + \sigma I(t) - \theta Q(t) - \mu Q(t), \\ \frac{dR(t)}{dt} = \theta Q(t) - \mu R(t), \end{cases} \quad (1)$$

Where the parameters and variables used are described in Table 1.

As the first four equations are independent of R(t), so omit without generality the last equation for R(t) and the modified system (1) becomes

$$\begin{cases} \frac{dS(t)}{dt} = A - \mu S(t) - \beta(N)S(t)E(t) + I(t), \\ \frac{dE(t)}{dt} = \beta(N)S(t)E(t) + I(t) - \pi E(t) - (\mu + \gamma)E(t), \\ \frac{dI(t)}{dt} = \pi E(t) - \sigma I(t) - \mu I(t), \\ \frac{dQ(t)}{dt} = \gamma E(t) + \sigma I(t) - \theta Q(t) - \mu Q(t). \end{cases} \quad (2)$$

For system (2), let N=A/μ, s=S/N, e=E/N, I =I/N and q=Q/N, and rescale the system (2) to get then normalized form

$\frac{ds}{dt}$= μ – μs –βNs(e + i), (3)

$\frac{de}{dt}$= βNs(e + i) – πe – (μ + γ)e, (4)

$\frac{ds}{dt}$= πe – σi -μi, (5)

$\frac{dq}{dt}$= γe + σi – θq – μq, (6)

with the initial conditions

$s(0) = s_0 \geq 0$, $e(0) = e_0 \geq 0$, $i(0) = i_0 \geq 0$, $q(0) = q_0 \geq 0$ (7)

In the remaining sections, we will discuss the local and global stability of the proposed model with initial conditions. First, a result is observed for the positivity and boundedness of the solution of system (3).

Lemma 1. Under the initial conditions (7), all the solutions $(s(t), e(t), i(t), q(t))$of system (3) remain nonnegative for $t \geq 0$.

Proof. By the initial conditions (7), it was discovered that

$\frac{ds}{dt}|_{s=0} = \mu > 0,$

$\frac{de}{dt}|_{e=0} = \beta Nsi \geq 0,$ (8)

$\frac{di}{dt}|_{i=0} = \pi e \geq 0,$

$\frac{dq}{dt}|_{q=0} = \gamma e + \sigma i \geq 0.$

Local Stability and Existence of Positive Equilibrium Point

The existence of unique positive equilibrium and stability of system (3) depends on the basic reproductive number R on free equilibrium point (FEP) C_0, which is determined with the help of the next generation matrix method [9]. The free corona virus equilibrium point is $C_0 = (1,0,0,0)$.

Consider the following matrices for finding the basic reproductive number $\Re_0$:

$$F = \begin{pmatrix} \beta Ns(e+i) \\ 0 \end{pmatrix},$$

$$V = \begin{pmatrix} \pi e + (\mu + \gamma)e \\ -\pi e + \sigma i + \mu i \end{pmatrix}. \quad (9)$$

Now Jacobian of F and V at C_0, are

$$F = \begin{pmatrix} \beta N & \beta N \\ 0 & 0 \end{pmatrix},$$

$$V = \begin{pmatrix} \pi + \mu + \gamma & 0 \\ -\pi & \sigma + \mu \end{pmatrix} \quad (10)$$

The dominant eigen value of FV^{-1}represents $\Re_0 = \rho(FV^{-1})$,which is

$$\Re_0 = \beta N \frac{\sigma + \mu + \pi}{(\pi + \mu + \gamma)(\sigma + \mu)}. \quad (11)$$

Theorem 2.

The system (3) is locally stable, related to virus-free equilibrium point C_0, $\Re_0 < 1$ and unstable if $\Re_0 > 1$.

Proof: For local stability at C_0, the Jacobian of system (3) is

$$J = (E_0) = \begin{pmatrix} M & -\beta N & -\beta N & 0 \\ 0 & \beta N - \pi - \mu - \gamma & \beta N & 0 \\ 0 & \pi & -(\sigma + \mu) & 0 \\ 0 & \gamma & \sigma & -(\theta + \mu) \end{pmatrix} \quad (12)$$

which follows the eigen values, $\lambda_2 < 0, \lambda_3 < 0 \; and \; \lambda_4 < 0$ and if $\Re_0 < 1$ and unstable if $\Re_0 > 1$.

Theorem 3. There exists a unique positive virus equilibrium point $C^*(s^*, e^*, i^*, q^*)$for system(3), if$\Re_0 > 1$.

Proof. By letting the right hand sides of all equations of system (3) to zero, as

$\mu - \mu s - \beta Ns(e+i) = 0,$

$\beta Ns(e+i) - \pi e(\mu + \gamma)e = 0,$

$\pi e - \sigma i - \mu i = 0,$ (13)

$\gamma e + \sigma i - \theta q - \mu q = 0$

Implies that

$$s^* = \frac{1}{\Re_0},$$

$$e^* = \frac{(\sigma+\mu)}{\pi} i^*,$$

$$i^* = \frac{\pi\mu\,(R_0-1)}{\beta N\,(\pi+\sigma+\mu)} \qquad (14)$$

$$q^* = \frac{\gamma(\sigma+\mu)+\pi\sigma}{\pi(\theta+\mu)} i^*$$

From the value of i^*, it is obvious that all the values of(s^*, e^*, q^*) are positive if $\Re_0$>1.

Theorem 4. If $\Re_0$< 1, then the system (3) is globally stable.

Proof. For the proof of the theorem, first, we construct the Lyapunov function L as

$$L = (e - e_0) + \frac{\beta N}{\sigma+\mu}(i - i_0) \qquad (15)$$

Differentiating equation (15) with respect to time and keeping the reality in mind that $\Re_0$< 1 and 0 < s < 1, we obtained

$$L' = e' + \frac{\beta N}{\sigma+\mu} i,$$

$$L' = \beta N\beta se + \beta Nsi - (\pi+\mu+\gamma)e + \frac{\beta N}{\sigma+\mu}(\pi e) - \frac{\beta N}{\sigma+\mu}(\sigma+\mu)i,$$

$$L' = \beta N\beta se + \beta Nsi - (\pi+\mu+\gamma)e + \frac{\beta N}{\sigma+\mu}(\pi e) - \beta Ni,$$

$$\leq \beta Ne - (\pi+\mu+\gamma)e + \frac{\beta N}{\sigma+\mu}(\pi e) = (R_0-1)e. \qquad (16)$$

Therefore, if R_0< 1, then L'< 0, which implies that the system (3) is globally stable forR_0< 1.

NUMERICAL METHOD AND RESULTS

The NSFD method is used for the numerical solution of the proposed model (3). Basically, NSFD is an iterative method in which we get closer to solution through iteration [8,10].

Let nonstandard ODEs be given as follows:

$$y_k' = f(t, y_1, y_2 \ldots\ldots y_n), \qquad (17)$$

where k=1,2,.n, then, by the NFSD method

$$y_1' = \frac{y_{1,K+1}-y_{1,k}}{h},$$
$$y_2' = \frac{y_{2,K+1}-y_{2,k}}{h}, \qquad (18)$$
$$\vdots$$
$$y_n' = \frac{y_{n,K+1}-y_{n,k}}{h},$$

Now, using the NSFD method for numerical solution of system (3), it follows that

$$s_{k+1} = \frac{h\mu + s_k}{(1 + h\beta N_k i_k + h\beta N_k e_k + h\mu s_k + 1)},$$

$$e_{k+1} = \frac{h\beta N_k s_{k+1} i_k + h\beta N_k s_{k+1} e_k + e_k}{(1+h(\pi+\mu+\gamma))}, \qquad (19)$$

$$i_{k+1} = \frac{h\pi e_{k+1} + i_k}{1 + h(\sigma + \mu)},$$

$$q_{k+1} = \frac{h\gamma e_{k+1} + h\sigma i_{k+1} + q_k}{1 + h(\theta + \mu)}$$

We assume the parameters of the system (3) shown in Table 1[3]. Figure 2 shows the solutions for $S(t), E(t), I(t), Q(t)$, and $R(t)$ obtained by NSFD, RK4, and ode45 for $\Re_0 > 1$, which show that it is unstable and will never become stable because of contact rates of infected people to susceptible people. So according to the act of Governments to keeping people within specified bounds (may be their home (stay at home and save your lives), offices, etc.), the contact rate will be controlled and so the current pandemic, otherwise, no control is possible. For $\Re_0 < 1$, when the contact rate becomes smaller, then, the current infectious disease may be controlled (see Figure 3).

CONCLUSION

In this work, we presented that isolation of the infected human overall can reduce the risk of future COVID-19 spread. Our model shows that the corona virus spreads through contact and describes how fast something changes by counting the number of people who are infected and the likelihood of new infections. Those new infections are what induce the epidemic. For this reason, we think that this research may lead to better guessing of the spread of this pandemic in the future. This paper is devoted to implementing the corona virus mathematical model containing isolation class. The reproductive number-related stability is discussed, which showed the impact of interaction of infected people to susceptible populations and proved graphically and analytically that if we control this contact rate, the control of the current disease is possible, otherwise. State and territory governments have different restrictions in place for public gatherings. Therefore, citizens need to follow the directions from time to time to minimize the health risk. This study may lead to better guessing the spread of this pandemic in future. We develop a mathematical model to present the dynamical behavior of COVID-19 infection by incorporating isolation class. In this work, we presented that isolation of the infected human overall can reduce the risk of future COVID-19 spread. Our model shows that the corona virus spreads through contact and describes how fast something changes by counting the number of people who are infected and the likelihood of new infections. Those new infections are what induce the epidemic. For this reason, we think that this research may lead to better guessing of the spread of this pandemic in the future. Further research should focus on updating the predictions with the use of up-to-date data and using more complicated mathematical models.

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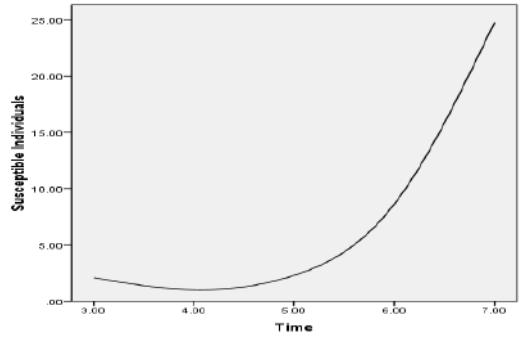
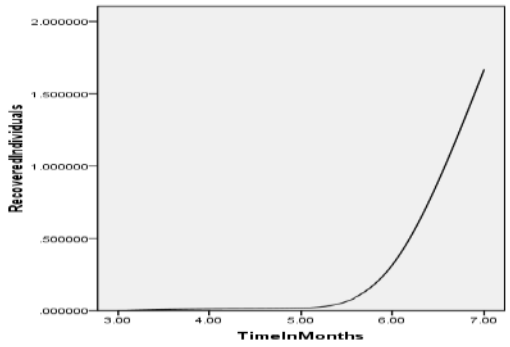
Table 1: Parameters and description. Symbols Description

S Susceptible population
E Exposed population
I Infected population
*Q*Isolated population
R Recovered population
β - Rate at which susceptible population
moves to infected and exposed class
π - Rate at which exposed population
moves to infected one
γ -Presents the rate at which exposed
people take onside as isolated
σ -Shows the rate at which infected people
were added to isolated individual
θ - Rate at which isolated persons recovered
μ - Natural death rate plus disease-related death rate

The population of susceptible



The population of exposed



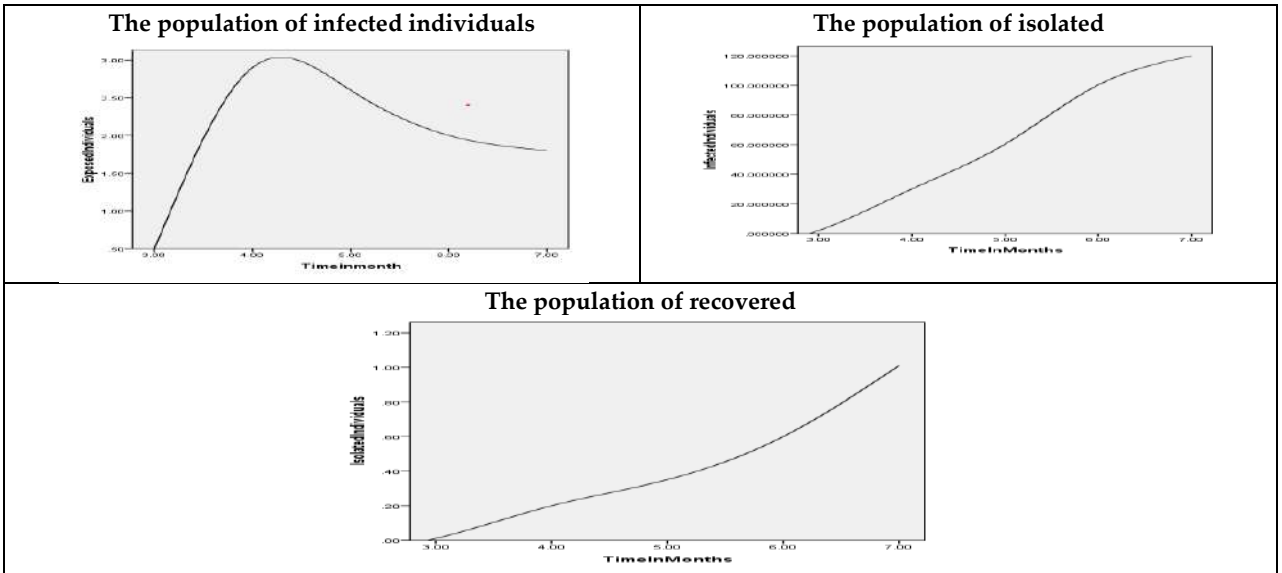


Fig1: Plots present the susceptible, exposed, infected, isolated, and recovered population when $\mathfrak{R}_0 > 1$

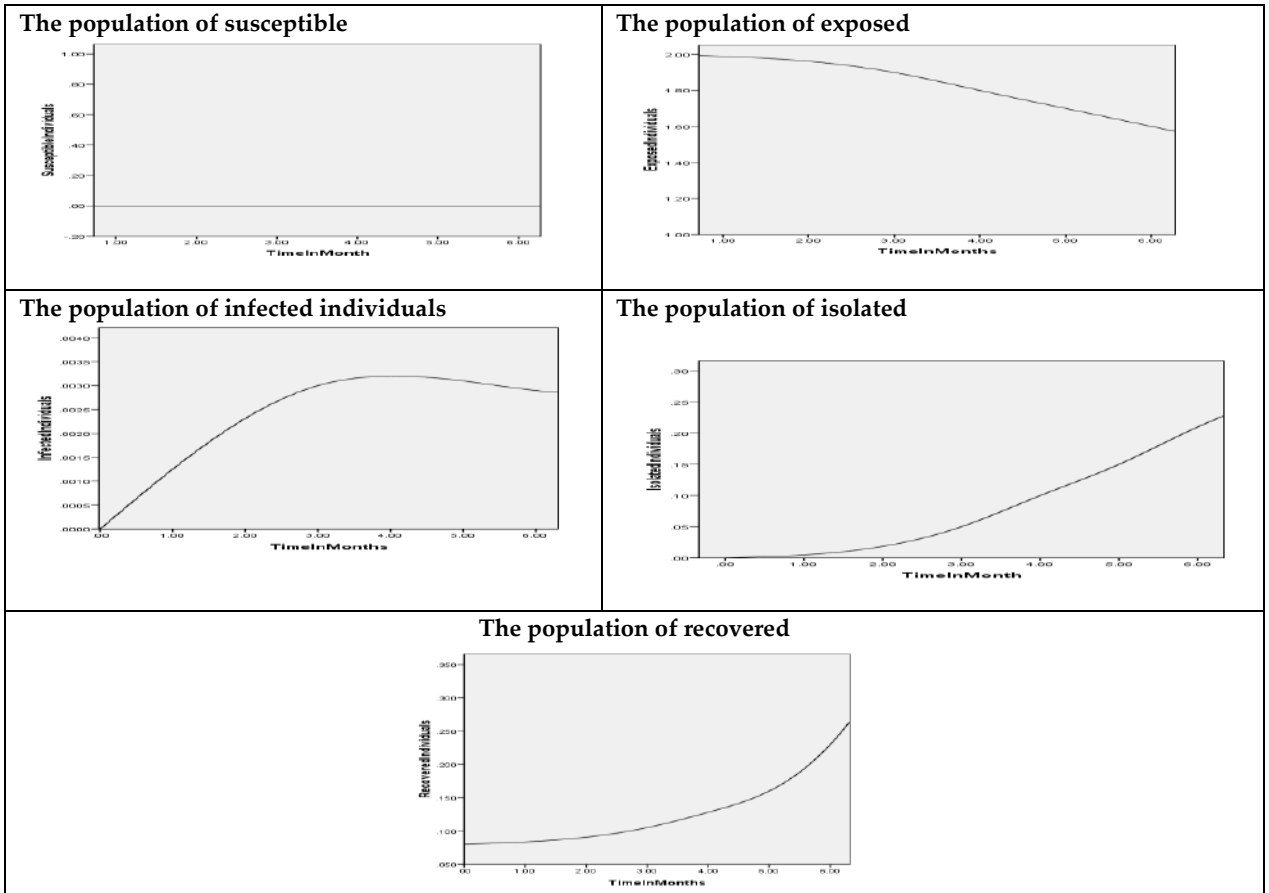


Fig2: Plots present the susceptible, exposed, infected, isolated and recovered population when $\mathfrak{R}_0 < 1$

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RESEARCH ARTICLE

The Effectiveness of Structured Teaching Programme on Knowledge Regarding usage of Selected Emergency Drugs among GNM Students in College of Nursing, Kanpur

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ABSTRACT

A situation when a person needs vital and sudden high-quality care in medical and also in nursing to save the life of the person is said to be Emergency. Emergency department is depicts to render health services to the patients who are physically unstable and requires uninterrupted examination and treatment based on their conditions. Nurses are encounter first with many emergency and life-threatening conditions so they should be enough competent and knowledgeable while providing care to such patients. Before handling the student nurses should know all about the emergency medicines such as their action, indication, contraindication, and side effects, route of administration, doses, and nursing care during, before and after administration of drugs. The present study aims to assess the level of knowledge, to assess the effectiveness of structured teaching programme regarding usage of selected emergency drugs, and to find the association between level of knowledge with their selected demographic variable. In this study pre-experimental one group pre-test and post-test research design was adopted, 120 sample was selected by using non probability convenient sampling technique. The data was collected by using self-structured closed ended questionnaire which contains 25 multiple choice questions was considered appropriate for assessing the knowledge. The study result showed that in pre-test 112 (93.33%) had inadequate knowledge, 8 (6.67%) had moderately adequate knowledge and 0(0%) students had adequate knowledge. In post-test after giving structured teaching programme 44 (36.33%) were having adequate knowledge, 66 (55%) were having moderately adequate knowledge and 10 (8.67%)

were having inadequate knowledge. The study resulted that structured teaching programme was effective in increasing the level knowledge regarding usage of selected emergency drugs among GNM Students.

Keywords: Assess, Effectiveness, GNM students, structured teaching programme, Knowledge, and Emergency drugs.

INTRODUCTION

Any situation when a person needs a quick and high standard care in medical and nursing is said to be Emergency Situation. This situation may be happened due to raised road traffic accidents, fast industrialization, bio war and other terrorist attacks, disasters etc [1]. emergency department can be called as emergency room or ward or casualty in hospitals around India. During the 20th century, in reply to expanding needs for fast assessment and controlling of critical illness emergency department was developed. This department serves emergency services to the community people at any time whenever they need it[2]. The department is also meant to distribute health services for the people those who were physically unstable and need uninterrupted examination and treatment based on their conditions[3]. Managing of varies cases among all the clinical areas and also imparts awareness about the quality of care provided in the hospital was maintained by emergency ward[4].Emergency drug is regulated promptly and giving continuous treatment during critical condition like cardiac failure, CVA, respiratory arrest or failure, discharge from wounds etc [4]. Emergency care is a care rendered during the first few hours immediately after an acute situation e.g., a childbirth complication, heart attack, injury, or any health problem that reaches an acute stage and poses a threat to life[5] .When the patient comes to the hospitals on emergency the family members and the patient expect excellent medical services from the hospital [6]. Nursing care has an intense role in the emergency unit because they are the people who are present round the clock with the patient and it is necessary, they have adequate knowledge. In order to perform their duties and procedure the student usually includes individualize plan for clinical assessment diagnosed of expected treatment outcome for each patient and to develop the critical services supporting critically ill patient throughout the hospital [7].

In Indian severe chest pain, breathing difficulties, excessive bleeding, burns of moderate to severe harshness, fracture, sudden onset of seizure episodes, loss of consciousness, drug over dose and poisoning, pregnancy complications and show on are considered to be an emergency condition that requires acute institutional management[8]. Emergency drugs are used for treatment of emergency condition like myocardial infarction, respiratory arrest and shock stoke for a short period of time of treatment. Student nurses work in emergency in various clinical setting where they are encounter of different type of emergency situation[9]. Before handling emergency drugs the student nurses should know about the thinks, about the emergency medicines such as action, indication, contraindication, route of administration, side effect, doses and nursing care after and before administration of medicine[10]. A medication is indicated as any substance suggested for the use in fixing, helping, treating or avoiding of illness or anticipated to impact he structure or ability of the body. Administration of emergency drugs plays a vital role in saving life in all critical situation, where by these drugs help to restore a person's life, and thus helps to maintain hemodynamic state. The nurse is in a unique position regarding drugs therapy, because when drugs are administered the body begins a sequence of process designed to handle the new chemicals[11]. Administered of medicine is a basic activity in nursing practice. As a result of the transition from hospital and institutions to community-based services, an increasing number of nurses are practicing in a variety of settings. Nurses therefore must be knowledge able about the actual drugs and their administration, client response, drug interactions, client allergies, and related resources. There is need to conduct teaching programme on emergency drugs on emergency drugs to improve and update nurses knowledge in order to minimize or prevent and occurrence of medication errors and increase patient safety [12].

Need of the Study

The study aims to inspects the learning experience of student nurses during their clinical practice. It is an important part in education that learning takes place during their clinical practice is considered in nursing, so it was termed as practice-based profession. Hence, the standard of nursing education predominantly based on the clinical experience where the student nurses gains the experience[13]. Nurses expertise is build on the proficiency and skill educated to them. Drug administration is a fundamental part of every day in nursing profession. No medication is completely safe and protected in this manner. Therefore, nurses need to have an intensive and broad knowledge of the medications and its method of organization in the compelling treatment of patients whose life lies in her grasp[14].Human life is very valuable. When any person is admitted to critical care unit life is critical or dangerous situations. The nurses who face such complex should have expert skills, knowledge and judgment to manage such critical incidents. They need to be updated their knowledge according to modern nursing research and practices. They must be able to apply their knowledge in practices successfully. The nurses who monitor patient continuously in the critical care units acts as drugs administrator and is the coordinator and collaborator of services as well. The students face more failure while recognizing the challenges and difficulty during the learning situation which saves them from significant training. The utmost aim of the triage system is to enhance the triage process. It is vital that patient was assessed and reassessed quickly which helps to stable the patient for treatment. Actual requirement of triage system is to connect each patient to the proper resources at the proper place and at the proper time. When the quantity and severity of injuries overwhelm the operative capacity of health facilities, a different approach to medical treatment must be adapted. The principle of "First Come, First Treated" is not followed in mass emergencies. Triage consist of rapidly classifying the injured on the basis of their survival with prompt medical intervention[15].

Statement of the Problem

A study to assess the effectiveness of Structure Teaching Program on knowledge regarding usage of selected emergency drugs among GNM students in College of Nursing, Kanpur, UP.

Objectives

To assess the level of knowledge regarding usage of selected emergency drugs among GNM 3rd year.
To assess the effectiveness of STP on level of knowledge regarding usage of selected emergency drug.
To associated the level of knowledge regarding usage of selected emergency drugs with their selected demographic variable.

Assumption

The study assumes that-
GNM students may have inadequate knowledge regarding usage of selected emergency drugs.
GNM students may have poor knowledge regarding usage of selected emergency drugs.
Structured teaching Programme may help in improving knowledge of GNM students regarding usage of selected emergency drugs.

Hypothesis

H_1- There is a significant difference in the level of knowledge on usage of emergency drugs after STP.
H_2- there is significant association of pre-test knowledge score with their demographic variables regarding usage of selected emergency drugs.

METHODOLOGY

Research Approach

Evaluative Research Approach is used in this study.

Research Design
One group pretest- posttest design (Pre-experimental research design) is use in this study.

Research Variable
Independent Variable
In the present study the independent variable refers to the structured teaching Programme on usage of selected emergency.

Dependent Variable
In this present study the dependent variable refers to the knowledge of GNM students regarding usage of selected emergency drugs.

Demographic Variable
The included includes age, any previous knowledge and any clinical experience in usage of selected emergency drug.

Population
The population for the present study is GNM students.

Accessible population
GNM students of selected College of Nursing who fulfilled the inclusion and exclusion criteria are accessible population in this study.

Sampling
Sample
The sample of research study consist of GNM students in selected Nursing Colleges, Kanpur, U.P. who fulfilled the sampling criteria.

Sample size
Sample size is **120GNM students**.

Sampling Technique
In this research study, **convenient sampling technique,** is adopt to select the samples.

Development and Description of Tools used in the Study
The tool to elicit and explore the knowledge regarding usage of emergency drugs among GNM students in clinical area is developed by investigator through self- structured closed ended questionnaire.

The Tool Consist of Two Sections
Section A: Baseline Proforma which involves the socio demographic data like age, previous knowledge about emergency drugs, and clinical experience in emergency area.
Section B: Consist of 25 self-structured multiple choice questionnaire related to knowledge regarding usage of selected emergency drugs among GNM students in Rama College of Nursing. For each correct answer carries one mark.

Data Analysis and Interpretation
Section-A Frequency of pre-test and post-test knowledge score among samples.
(Table No.2 Fig No.1) The above table shows the level of knowledge score of the samples regarding knowledge of usage of selected emergency drugs among the nursing students in pre-test out 120, 112 (93.33%) had inadequate knowledge and 8 students (6.67%) have moderately Adequate knowledge. In post test, 66 (55%) were having

moderate adequate knowledge, 44 (36.67%) were having adequate knowledge and 10 (8.33%) were inadequate knowledge. Table 3shows that the Mean and standard deviation of pre-test knowledge score in pre test was 9.33 and 3.45 and in post test were 17.81 and 3.52 respectively.

Section- B

Table 3 shows that the effectiveness of STP by paired "t" value was 14.35 which clearly show that Teaching Programme was significantly enhancing the knowledge of student regarding usage of selected emergency drugs.

Section-C Association between Pre-Test Knowledge score with selected demographic variable.

The association between level of knowledge score on pretest with selected demographic variables of GNM students like age, clinical experience and previous knowledge shows no significant.

Nursing Implication

Nursing Practice

The study result contributes many suggestions in nursing practice. A structured teaching programme is new and creative method of teaching for nursing practice. It is particularly most economical educational plan to enhance the nursing practice and developing skills, and only skill nurses will assist to render better care to the patients which reduces complication regarding selected emergency drugs usage. A Structured teaching programme will be helpful for students in providing detail information regarding the usage of selected Emergency, it will provide assistant and confidence for students working in the emergency department to follow guidelines of the structured teaching programme.

Nursing Education

The students may feel fear while working in critical areas of hospital while rendering care to the patients due to reduced level of knowledge. Hence, teaching programme provides specific knowledge and serves as a guide during the training on care of the patient. Nursing education can also help the nursing students with proper knowledge and attitude to fulfill their duties and responsibilities in the field of nursing. The findings of the study can be used by nurse educator to educate the student nurses, which help then to provide an effective nursing care and to practice the management of patients while giving emergency drugs to the patients.

Nursing Administration

In each and every organizations (hospital) nursing administration must plan a separate budget in continuing education programs. Nursing administration should take initiative to conduct orientation programs for advance beginners. They must make sure that in-service education programs are conducted periodically. After training, the nurses should be provided with adequate facilities and supervision to maintain the standards of knowledge regarding learning disabilities and should evaluate the nursing practice for the effectiveness of in-service education.

Nursing Research

Nurses at present are sincerely give rise to, bringing out and applying research in nursing practice so that to enhance the knowledge related to emergency drugs usage and improve the notable knowledge base on nursing.

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Table 1: Represents scoring system on knowledge.

S.No	Score	Category
1	0 - 13	Inadequate Knowledge
2	14 - 20	Moderate adequate Knowledge
3	21 - 25	Adequate Knowledge

Table 2: Frequency and percentage distribution of sample according to their knowledge score.

N - 120

Knowledge Level	Pre Test		Post Test	
	Freq	Percent	Freq	Percent
Inadequate Knowledge	112	93.33	10	8.33
Moderately Adequate Knowledge	08	6.67	66	55.00
Adequate Knowledge	00	00	44	36.67

Table 3: Mean and Standard Deviation on knowledge score

N=120

Knowledge Level	Mean	Standard Deviation
Pre Test	9.33	3.45
Post Test	17.81	3.52

Table 3: Effectiveness of structured teaching Programme on knowledge regarding usage of selected emergency drugs.

Area	Calculated t Value	Degree of Freedom	Table Value	Inference
Knowledge	14.35	59	2.01	Significance

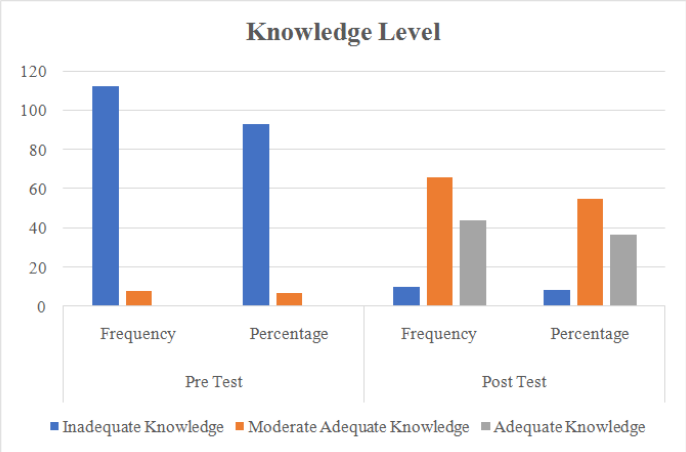

Fig 1 Bar Diagram shows the knowledge level of students

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REVIEW ARTICLE

Development of Surgical Robots in Different Applications – A Review

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ABSTRACT

Surgical robots are helpful for necessary invasive surgery, since it enables precise of surgical instruments beyond medical professionals capability in a limited operation space. In this methodology, we are building up a miniature controller for minimally invasive neurosurgery. The miniature controller comprises of two miniature grasping manipulators, an unbending neuron endoscope, an attractions tube, and a perfusion tube. This article provides details regarding the miniature getting a handle on controller. It has two degrees of freedom for twisting and one degrees of freedom for getting a handle on. This model is 3.5 mm in measurement and can twist 40 degrees toward any path. Treated steel wire was utilized to activate the controller.

Keyword: Robotic Surgery, Urological surgeries, Thoracoscopic surgeries.

INTRODUCTION

History of Robotic Surgery

The previously recorded utilization of a robot-helped surgery happened in 1985 when the PUMA 560 mechanical careful arm was utilized in a sensitive neurosurgical biopsy, a non-laparoscopic medical procedure. The automated framework took into consideration an effective mechanical medical procedure and the potential for more prominent accuracy when utilized in negligibly obtrusive medical procedures, for example, laparoscopies which regularly use adaptable fiber optic cameras. The 1985 mechanical medical procedure lead to the first laparoscopic methodology

including an automated framework, a cholecystectomy, in 1987 [1]. The next year a similar PUMA framework was utilized to do a mechanical medical procedure transurethral resection. In 1990 the AESOP framework created by Computer Motion turned into the main framework supported by the Food and Drug Administration (FDA) for its endoscopic surgery.

In 2000, the da Vinci Surgery System kicked off something new by turning into the main mechanical medical procedure framework endorsed by the FDA for general laparoscopic medical procedure. This was the first run through the FDA endorsed a comprehensive arrangement of careful instruments and camera / scopic utensils. Its archetypes depended upon the utilization of endoscopes and various careful aides to do a medical procedure. The da Vinci automated a medical procedure framework's three-dimensional amplification screen permits the specialist to see the usable territory with the clearness of high goal. The one-centimeter distance across careful arms address a critical headway in mechanical medical procedure from the early, huge equipped frameworks. Example, the PUMA 560. With such scaled down working arms, the da Vinci automated a medical procedure framework eliminates the need to use the sides of the cut dividers [2]. This progression takes into account less contact between uncovered inside tissue and the careful gadget, significantly decreasing the danger of disease. The "Endo-wrist" highlights of the working arms absolutely reproduce the gifted developments of the specialist at the controls, improving exactness in little working spaces [3].

The da Vinci system has been approved by the FDA for use in both adult and pediatric robotic surgery procedures in the following areas:

- Urological surgeries
- General laparoscopic surgeries
- General non-cardiovascular thoracoscopic surgeries
- Thoracoscopically-assisted cardiotomy procedures

Applications for Robotic Surgery

Since mechanical medical procedure is at the front line of exactness and scaling down in the domain of medical procedure, the potential applications are pretty much as broad as the employments of insignificantly obtrusive medical procedure. Automated a medical procedure has effectively become a fruitful choice in neurological, urological, gynaecological, cardiothoracic, and various general surgeries. Instinctive Surgical, creators of the da Vinci mechanical medical procedure framework, have delivered redesigns in the quantity of working arms, dispensing with the requirement for one careful associate, which may extend its clinical applications [4].

The Future of Robotic Surgery

The eventual fate of automated a medical procedure is close to as promising as the human will to concoct better methods of achieving fragile operations. It is sensible to expect that the current benefits of automated a medical procedure frameworks will be developed in the up and coming age of clinical mechanical technology. Eliminating human contact during a medical procedure might be taken to a higher level with automated a medical procedure frameworks equipped for working at more noteworthy distances between specialists control reassure and the patient side table mechanical technology.

This would permit mechanical medical procedure to be led with patients in a close by "tidy up room," lessening or wiping out the intra operative contamination. It is feasible for cutting edge clinical mechanical technology and automated a medical procedure to direct careful prep work distantly also. Headways in making mechanical medical procedure frameworks more equipped for recreating the material feel and sensation a specialist encounters during more obtrusive conventional methodology would give the specialist the smartest possible solution [5]. The specialist would acquire the exactness and benefits of insignificantly intrusive methodology without losing the tactile data supportive in settling on decisions during automated a medical procedure.

Different types of Robotic Systems

Robots in Urological Surgeries

A little orange put inside a profound cavity, which is little to the point that just one hand can venture into it. Presently envision that the orange must be stripped with one hand. This is the trouble a specialist faces when he needs to deal with the prostate organ, which is arranged in the human pelvis. Presently envision the specialist eyes being set 5 creeps from the orange, with instruments as little as pencils copying and surpassing the scope of movement of the hands and fingers. The undertaking at that point turns out to be extraordinarily basic. This is the benefit of Robotic Urological medical procedure over Laparoscopic medical procedure. There are explicit regions and sickness measures in the human body that are extremely well-suited for automated a medical procedure. One of them is the pelvis (the lower part of the storage compartment between the midsection and the thighs) and its organs (prostate, urinary bladder and uterus).

Significant medical procedure for prostate malignancy has been decreased to a simple 24 hours of emergency clinic stay, with patients strolling 4 hours after medical procedure and returning to work in a couple of days' time. Infections of the kidneys, bladder, are totally managed utilizing automated a medical procedure. The account of Robotics, where the working specialist surrenders his blessed situation adjacent to a surgical table, to a seat situated a couple of feet away, started in the 1980 in the USA when NASA, Stanford Research Institute, and the US Department of Defence built up the SRI Tele presence Surgery System, which was planned to help the injured in a fight by specialists miles from the cutting edge. Despite the fact that it didn't achieve the proposed unbiased, this careful framework at last prompted the advancement of the current day Da Vinci Robotic System. In 2006, India saw its first Robotic Assisted Surgery, and a Robotic Radical Prostatectomy was finished effectively. We have surely progressed significantly from that point forward [6].

Urology is unquestionably the herald in the utilization of Robotic innovation. The quantity of Radical Prostatectomies being performed has gone up immensely when contrasted with the open period [7]. The improved safeguarding of urinary moderation after medical procedure (a few patients report self-control as right on time as day 1 or day 2 post catheter evacuation) and the lesser occurrence of erectile dysfunctions because of better nerve saving have made revolutionary prostatectomy as the lead a medical procedure of advanced mechanics around the world. The benefits have additionally been stretched out to methodology requiring exactness and precision like Partial Nephrectomy, which has empowered effective nephron saving a medical procedure which brings about kidney work conservation. Mechanical helped Adrenalectomy, Pyeloplasty, Radical nephrectomy and Donor nephrectomy are being performed with expanded recurrence. With Indians at the front line of Robotics around the world, it isn't preposterous to expect the advancement of a native mechanical careful framework later on. Steve Jobs broadly said "Everybody here has the feeling that correct now is one of those minutes when we are impacting what's to come". Seeing and effectively partaking in the fast development and spread of Robotic innovation in India, one can't resist the urge to have a similar feeling of Robotics forming the fate of wellbeing conveyance in India [8].

Cardiothoracic Robotic Surgery

UC Davis Medical center presently offers automated helped systems to treat cardiovascular illness and non cardiac thoracic infection. This best in class program incorporates an accomplished and profoundly prepared group of specialists, medical caretakers and care staffs that have practical experience in the utilization of a PC controlled careful framework that can give every one of the advantages of customary open-heart and other cardiothoracic medical procedure with the recuperation benefits of a negligibly obtrusive strategy. For heart cases, the group additionally works intimately with partners in the Division of Cardiovascular Medicine to give the most suitable and best blend of medicines for every quiet [9]. Thoracic medical procedure cases are composed in a multidisciplinary approach through the UC Davis Comprehensive Cancer center including professionals from Medical and Radiation Oncology just as Pulmonary Medicine.

Mechanical helped a medical procedure is a main edge system. It is negligibly intrusive - which means huge careful cuts are not needed — and the exactness of the innovation can be an ideal alternative for fragile and complex medical procedures around the heart and in the chest. Right now, UC Davis is the lone clinical focus in California offering mechanical helped, multi-vessel "crossover" coronary detour/revascularization systems for patients experiencing coronary corridor infection.

Advantages to patients

Mechanical helped a medical procedure empowers specialists to play out a more exact activity less obtrusively than traditional cardiothoracic medical procedure. "Open" heart medical procedure commonly requires the chest to be opened at the sternum bone and the utilization of a heart-lung machine and customary thoracic medical procedure includes scaling muscles toward the back and spreading ribs separated to get to the thoracic organs. The automated helped choice offers a few likely advantages, including:

- Altogether less agony
- Less blood misfortune
- Less danger of contamination
- Less scarring
- More limited clinic stay
- Speedier recuperation time and recover to ordinary exercises
- Clinical results practically identical to traditional "open" heart medical procedure
- Clinical and oncologic results tantamount to VATS (video-helped thoracic medical procedure)

Likewise with any surgery, these advantages can't be ensured. Fruitful results consistently rely upon an assortment of variables

Coronary conduit sidestep (coronary revascularization).

This strategy is performed without the requirement for a heart-lung machine. It is done insignificantly obtrusively through little entry points made between the ribs. It dodges the actual injury of slicing through the bosom bone and spreading the ribs to get to the heart region, which conveys related dangers and complexities. UC Davis specialists can fix various sick vessels utilizing the automated helped system. Cardiothoracic specialists likewise perform arrhythmia, pericardial, and lead situation automated helped strategies.

Aspiratory resection

This system is performed with numerous little cuts between the ribs and doesn't include spreading any ribs separated. This methodology limits actual torment to the patient while giving admittance to the lung and its blood supply with incredible optics given by the automated camcorder. UC Davis specialists can eliminate little segments of lung tissue, whole lungs and related lymph hubs utilizing the mechanical helped methodology. Cardiothoracic specialists likewise perform mediastina tumour resections, oesophageal resection and fix and diaphragmatic systems [10].

CONCLUSION

During the usable methodology the specialist sits at a controlling console close to the patient. A helping specialist is at the bedside close to the patient. Through a camcorder, the working specialist watches the usable field and controls a few automated arms from the comfort, which repeat the specialist's hand developments. Three PCs at the comfort track those developments 1,000 times each second, digitizing the data and empowering exceptional careful accuracy. PC helped automated a medical procedure permits strategies to be played out that beforehand were past the abilities of human manual aptitude.

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Fig.1: Robot Surgery Device

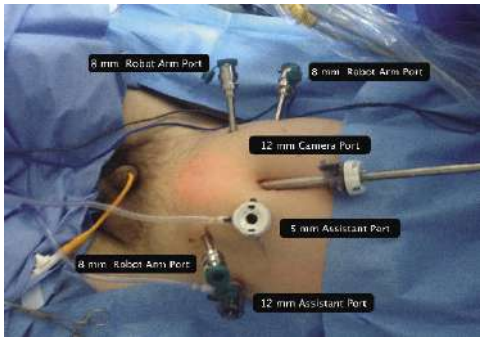

Fig.2: Urological Surgeries using Robots

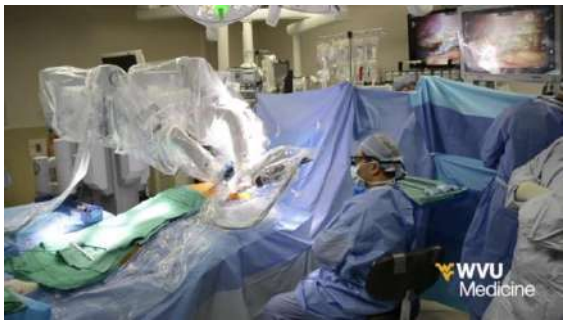

Fig. 3: Cardiothoracic Robotic Surgery

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RESEARCH ARTICLE

Micronutrient Insufficiency and Cardiovascular Risk in Metabolic Syndrome

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ABSTRACT

Metabolic syndrome (MS) is a collection of biochemical and hormonal alterations that increase the risk of type 2 diabetes and cardiovascular disease. Several studies have been conducted to identify more precise diagnostic and prognostic signs for metabolic syndrome. While worldwide research is continuing, few in-depth studies exist. This research attempted to establish a connection between metabolic syndrome and micronutrient status. A deficiency in vitamin D and other micronutrients has been associated with obesity, atherogenic dyslipidemia, and cardiovascular health. It has been hypothesized that dietary micronutrients protect against oxidative damage and accompanying clinical consequences. It is possible that a deficiency of micronutrients like antioxidants (vitamin B6, vitamin C, vitamin E). These micronutrients, along with others like folic acid, vitamin B12, and vitamin B6, may affect intracellular homocysteine concentration, influencing the progression of chronic diseases. Vitamin D, Vitamin C, Folate, Vitamin B6, Vitamin B12, Magnesium, Zinc, Calcium, and Phosphorus were inadequate or reduced in the test group compared to the control population. This study examined micronutrients' influence on MS progression. Micronutrients are seldom consumed separately, metabolic rates differ, and trace elements may be the source of diverse dietary study outcomes. The present study reveals no association between Vitamin D, Vitamin C, Folate, Vitamin B6(PLP- Pyridoxal phoshate), Vitamin B12, Magnesium, Zinc, and Calcium and APO B, indicating no immediate cardiovascular risk outcome associated with nutritional deficiencies. However, it is noted that nutritional deficiencies contribute to the progression of MS, resulting in increased CVD risk in the test population studied.

Keywords: Metabolic syndrome, Micronutrients, Cardiovascular disease, Biomarkers, Nutritional deficiency

INTRODUCTION

Micronutrients in the diet have been postulated to protect against oxidative damage and its clinical consequences[1]. Micronutrients play essential roles in releasing energy for synthesis, movement, and other cellular and biochemical processes through their roles as coenzymes, cocatalysts, and buffers [2]. Effects on intracellular homocysteine concentration from subclinical deficiencies of several micronutrients, including antioxidants and others like folic acid, vitamin B12, and vitamin B6, may have significant effects on the progression of chronic disease by influencing inflammation and oxidative stress [3]. The significant chronic metabolic disturbance may occur when micronutrient intake falls below the current dietary recommendation. It is generally accepted that the risk of metabolic syndrome (MS) and related disorders is elevated when inflammation and oxidative stress interact. Several studies have pointed to the potential importance of dietary antioxidant consumption in protecting against oxidative stress and its associated clinical problems [4]. Obese people are more likely to have deficiencies in magnesium (Mg), iron (Fe), vitamin B6, vitamin E, vitamin B12, folic acid, selenium, copper, and zinc (Zn) [5]. These deficiencies may develop due to insufficient nutrient intake (diet, supplements) or as a consequence of changes in nutrient absorption or metabolism. Increased production of potentially harmful by-products of incomplete biochemical processes has been linked to excessive caloric intake and the onset of obesity and related metabolic diseases[6]. It has been found that a diet high in fiber, folic acid, vitamins A and C, magnesium, selenium, and zinc increases total antioxidant capacity (TAC) significantly [7]. However, research shows that TAC is inversely related to systolic blood pressure, serum glucose, and free fatty acids. This result holds regardless of a person's gender or calorie intake. On the other hand, the negative correlations between micronutrient consumption and multiple sclerosis are not well understood. Therefore, investigating the possible function that these nutrients play in multiple sclerosis might give further impetus for developing intervention strategies that could lower the morbidity associated with multiple sclerosis and, eventually, cardiovascular disease (CVD). In light of this, this study aimed to investigate the association between micronutrient consumption and multiple sclerosis (MS) by contrasting the levels of micronutrient consumption among people with MS and those who did not have MS.

MATERIALS AND METHODS

Participants with Metabolic Syndrome ranged in age from 25 to 60 years old were studied. The National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) MS criteria were used to categorize the participants. Each participant was administered a standardized questionnaire to collect data on their behavioral, medical, personal, and family history. Lipid profile and nutrient analysis were photometrical.

RESULTS AND DISCUSSION

The traditional risk indicators for CVD are described in Table 2; data are reported as mean and standard deviation. Table 3 compares the serum levels of several risk factors in people with and without metabolic syndrome.

Table 3 compares metabolic syndrome patients' serum risk indicators. Z = -4.330 and p = 0.000 for BMI. Ap-value of less than .05 contradicts the null hypothesis and demonstrates a significant difference in BMI between patients with and without metabolic syndrome. SBP's Z= -10.266, p= 0.000. We reject the null hypothesis because the p-value is less than 0.05. DBP has a -5.779 Z statistic and 0.000 p-value. Because the p-value is less than 0.05, we reject the null hypothesis and find that DBP levels vary in metabolic syndrome. FBS's p-value is 0.000. The null hypothesis is rejected because of p-value less than 0.05. PPBS's Z statistic is -13.247 and p=0.000. PPBS levels vary between people with and without metabolic syndrome (p-value less than 0.05). For TC, Z=-12.470 and p=0.000. The null hypothesis is rejected because of p <0.05. TG's Z statistic is -6.646% and p=0.000. We reject the null hypothesis because of p <0.05. HDL's Z statistic is -5.356 and p=0.000. We reject the null hypothesis to suggest that metabolic syndrome participants had lower serum HDL values. Serum LDL has -10.596 Z statistic and 0.000 p-value. We reject the null hypothesis

because of p< 0.05.For APO B Z = -3.19 with a 0.001 p-value. Asp is <0.05 we reject the null hypothesis and demonstrates a significant difference in APO B serum levels between metabolic syndrome patients and controls. APO A1 hasa -0.528 Z statistic and 0.597 p-value. The p-value for APO A1 serum levels in persons with and without metabolic syndrome is >0.05.So, we accept the null hypothesis.

Table 4 presents correlation data regarding the association between micronutrients and emerging indicators. Neither vitamin D nor vitamin C nor folate nor vitamin B6, (PLP) nor vitamin B12 nor magnesium nor zinc, or calcium has any correlation with APO B. Phosphorus and APO B have a weakly negative correlation. Vitamin D, Vitamin C, Folate, Vitamin B6 (PLP), Vitamin B12, Zinc, Calcium, and Phosphorus do not have a statistically significant association with APO A1. It seems that APO A1 and Magnesium have a weakly negative link. The current study finds no association between Vitamin D, Vitamin C, Folate, Vitamin B6(PLP), Vitamin B12, Magnesium, Zinc, and Calcium and APO B; this finding suggests that there is no immediate cardiovascular risk outcome associated with nutritional deficiencies. However, nutritional deficiencies contribute to the progression of multiple sclerosis, which increases the risk of cardiovascular disease in the tested and studied population. The human environment, as well as people's routines and ways of living, has seen considerable changes in the last half-century. Because of these changes, there has been a rise in obesity. The increase in number of people with cardiovascular disease and secondary obesity makes metabolic syndrome important in clinical settings [8].

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Table 1 shows the nutritional status of the study population.
Descriptive Statistics of the micronutrients

		N	Mean	Std. Deviation
Vitamin D (ng/mL)	Experimental	120	15.9025	4.58563
	Control	120	32.1767	2.24199
Vitamin C (mg/dl)	Experimental	120	.8267	.27676
	Control	120	1.1708	.41534

Folate (5–20 ng/ml)	Experimental	120	14.5750	2.79755
	Control	120	15.5500	2.67214
Vitamin B6 PLP (5 - 50 µg/L)	Experimental	120	27.2750	9.21723
	Control	120	28.9750	9.06509
Vitamin B12 (20–80 ng/dl)	Experimental	120	53.7167	15.04122
	Control	120	57.8000	12.59558
Magnesium (1.8–2.2 mg/dl)	Experimental	120	1.8250	.16049
	Control	120	1.8375	.14785
Zinc (50–100 µg/dl)	Experimental	120	75.6583	12.42084
	Control	120	80.5750	10.54854
Calcium (mg/dl)	Experimental	120	9.3017	.56420
	Control	120	9.4217	.52950
Phosphorus (mg/dl)	Experimental	120	4.3667	.58859
	Control	120	4.5292	.47640

Table 2: Descriptive Statistics of the conventional risk factors

		N	Mean	Std. Deviation
BMI	Experimental	120	26.6992	4.97266
	Control	120	24.0408	4.48946
SBP(mmHg)	Experimental	120	142.6333	23.93055
	Control	120	119.7083	5.90456
DBP(mmHg)	Experimental	120	86.0333	5.97042
	Control	120	81.8667	4.61625
FBS	Experimental	120	162.4500	54.16406
	Control	120	86.2500	6.71040
PPBS	Experimental	120	217.0667	57.53607
	Control	120	123.3667	7.93983
TC (mg/dl)	Experimental	120	263.9750	38.53460
	Control	120	185.2917	13.77575
TG (mg/dl)	Experimental	120	129.1300	32.57588
	Control	120	103.7250	17.18215
HDL (mg/dl)	Experimental	120	44.3583	5.47998
	Control	120	48.5833	6.12967
LDL (Mg/dl	Experimental	120	142.0500	22.74996
	Control	120	109.2500	13.12208

Table 3: Mann-Whitney test for comparison of serum levels of various risk markers in subjects with and without metabolic syndrome

Test Statistics	Mann-Whitney U	Wilcoxon W	Z	p-value
BMI	4871.500	12131.500	-4.330	0.000
SBP (mmHg)	1934.000	9194.000	-10.266	0.000
DBP (mmHg)	4374.500	11634.500	-5.779	0.000
FBS	404.500	7664.500	-12.648	0.000
PPBS	80.500	7340.500	-13.247	0.000
TC (mg/dl)	496.500	7756.500	-12.470	0.000
TG(mg/dl)	3627.000	10887.000	-6.646	0.000
HDL (mg/dl)	4324.500	11584.500	-5.356	0.000
LDL (mg/dl	1505.500	8765.500	-10.596	0.000

APO B(g/L)	5486.500	12746.500	-3.191	0.001
APO A1(g/L)	6916.500	14176.500	-0.528	0.597

Table 4: Spearman's Rank Correlation results for the correlation between micronutrients and emerging markers

	APO B(g/L)		APO A1(g/L)	
	Correlation Coefficient	**Sig.(2-tailed)**	Correlation Coefficient	**Sig. (2-tailed)**
Vitamin D (ng/mL)	-0.127	0.166	0.17206	0.060
Vitamin C (mg/dl)	-0.00853	0.926	0.011922	0.897
Folate (5–20 ng/ml)	0.074	0.419	-0.05563	0.546
Vitamin B6 PLP (5 - 50 µg/L)	-0.159	0.083	0.017486	0.850
Vitamin B12 (20–80 ng/dl)	-0.11954	0.193	0.066	0.473
Magnesium (1.8–2.2 mg/dl)	-0.009	0.921	-.261**	0.004
Zinc (50–100 µg/dl)	0.068	0.460	-0.10896	0.236
Calcium (mg/dl)	0.069	0.455	-0.03484	0.706
Phosphorus (mg/dl)	-.197*	0.031	0.090	0.330

RESEARCH ARTICLE

Phytochemical Evaluation of *Cordia dichotoma* Leaves

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ABSTRACT

Cordia dichotoma, an ethnomedicinally valuable plant, can be used to treat many different types of maladies as an astringent, anthelmintic, diuretics, antiulcer, anti-diabetic, and expectorant in several traditional systems of medicine and among various ethnic groups in India. Maintaining performance standards has now become extremely important as a result of a growing market. The purpose of this work was to establish a standard pharmacogenetic, physicochemical, phytochemical, and fluorescence profile of *Cordia dichotomy leaves*. After leaf identification, preliminary phytochemical and physicochemical tests were performed, followed by fluorescence analysis as per standard technique. The final observations were written down. After extraction in aqueous and organic solvents, the samples were dried in a hot air oven at 105°C for 45 minutes. On drying at 105°C for 45 minutes in a hot air oven,

phytochemical screening revealed the presence of carbohydrate, alkaloid, saponin, cardiac glycosides, flavonoid, and phenolic chemicals.

Keywords: *Cordia dichotoma,* Fluorescence analysis, physicochemical parameters, etc.

INTRODUCTION

Herbal goods are complex mixes of organic substances derived from any raw or processed plant part, such as leaves, stems, flowers, roots, and seeds. Herbs are currently classified as dietary supplements under federal law[1].Herbs are used for the preparation of herbal medications. Herbs contain active constituents that are extracted from various plant parts [2]. Ayurveda and Unani are popular among India's diverse ethnic groups for their use as an astringent, anthelmintic, diuretic, demulcent, anti-diabetic, and expectorant in the treatment of a variety of diseases. Their leaves have long been utilized to treat jaundice in the Dandakaranya district of Andhra Pradesh, India[3]. *Cordia dichotoma* is a deciduous tree with a crooked trunk, a short bole, and a spreading crown. Leaves are elliptic-lanceolate to broadly ovate, with a round and cordate base, and are simple, whole, and somewhat dentate·[4].The stem bark is greyish-brown and smooth or wrinkled longitudinally. Flowers are white to pinkish, short-stalked, and emerge in loose corymbose cymes. Fruits with a sticky meat mass are edible. It's a globose or ovoid dazzling yellow or pinkish-yellow drupe situated in a saucer-like expanded calyx. When it ripens, it turns black and the pulp becomes viscid[4]**.**

Vernacular Names

Bhairala, Bhokar, Gondi, Guslasah, Lasora; Sanskrit: Bahuvaraka, Bhukampadaruka, Bhukarbudara, Bhuselu, Bhutadruma, Laghupichhila; Hindi/Indian: Bhairala, Bhokar, Gondi, Guslasah, Lasora; Hindi/Indian: Bhairala, Bhokar, Gond Sebesten Plum, Fragrant Manjack, Soap Berry; Lepcha: Ninut; Sinhalese: Lolu, Lotu; Unani: Sapistan; Arabic: Dabk; Myanmar: Thanet; Java: Kendal; Persian: Sugpistan, Sebestan, Sapistan; Tehran: Sepistan; Sino-Tibetan: Lao; Malay: petekat; Nepali: kalobohori, bohori

Local Names

Dilk; Bohari, buhul; Gujarati: Vadagunda; Marathi: Bhokar, Bhonkar; Kannada: Chikkachalli; Malayalam: Naruvari; Punjabi: Lasuda; Telugu: Nakkera; Tamil: Naruvili, Selu, Vidi[5].The tropics and subtropical regions are native to *C. dichotoma*. It can be found at elevations of up to 1500 m in the sub-Himalayan tract and outer ranges. It can be found in various of woodlands, including the Western Ghats' moist forest areas and Myanmar's tidal forests, as well as Rajasthan's dry deciduous forests. It also grows in the wet rainy season forest of Maharashtra[6]. Plant-derived medications are regarded as the first line of defence in sustaining health and battling a disease, and plant sources continue to be the primary source of new therapeutic drugs. There are an estimated 73,000 plant species with therapeutic characteristics with India recognizing more than 2,000 of them. Anti-diabetic, anti-ulcer, anti-inflammatory, immune-modulator, and analgesic activities have been documented in plant parts such as leaves, fruit, bark, and seed [7].

METHOD AND MATERIALS

Obtaining samples

Plant material of flesh *C.dichotoma* was collected from Durgdistrict Durg Chhattisgarh, India during the month of August –to September 2021.

Preparation of plant sample

Plant materials collected were washed under running tap water and were allowed to drain before air-drying for two weeks. The leaves together with the stem and small branches were ground mechanically with a motor and pestle.

Authentication

The Plant Materials Were Identified and Authenticated by Dr. Ranjana Shrivastava, Department of Botany, Govt Autonomous Tamaskar College, Durg Chhattisgarh 491001 India.

Collection and authentication of plant specimen: Leaves of the plant *Cordia dichotoma* for the study were collected from the nearby region of Durg, Chhattisgarh, and authenticated by govt. V.Y.T.PG. Autonomous college.

Solvents Used

Plant material was extracted using a Soxhlet device with petroleum ether, chloroform, and ethanol, and the drug was then boiled.

Chemicals Used

For phytochemical screening of the plant extracts, sodium hydroxide, copper sulfate, ferric chloride, sulphuric acid, iodine, lead acetate, magnesium, potassium iodide, potassium mercuric iodide, picric acid, mercuric chloride, nitric acid, gelatin, sodium chloride,α—naphthol sodium nitroprusside, pyridine was used.

Extraction process

Soxhlet extraction

When the target molecule has limited solubility in a solvent and the impurity is insoluble in that solvent, Soxhlet extraction is required. If the desired component has a high solubility in a solvent, it can be removed from the insoluble substance using simple filtration. The advantage of this approach is that instead of passing multiple batches of warm solvent through the sample, only one batch is recycled. The extraction of the plant was done using three different solvents. The first extraction method involves varying the quantities of the three basic extraction solvents: water, ethanol, and petroleum ether[8].

Procedure

About 10 gm of powdered material of *c. dichotoma* was extracted with ethanol as a solvent by hot extraction method using Soxhlet apparatus. The extraction was continued until the solvent in the thimble became clear then a few drops of solvent were collected in the test tube during the completion of the cycle and a chemical test of the solvent was performed. After each extraction, the extract was evaporated to dryness some part of the extract was preserved for preliminary Phytochemical screening for the detection of plant constituents[9].

Extraction methodology

- Preparation of petroleum ether leaves Extract of *C.dichotoma*
- Preparation of Ethanolic leave Extract of *C.dichotoma*
- Preparation of water Extract of *C.dichotoma*

Preparation of petroleum etherleavese Extract of *C.dichotoma*

C. dichotoma leaf powder was crushed to a coarse powder, defatted with 20 mL water and 80 mL ethanol, and extracted by Soxhlation. The concentrated ethanolic extract was then evaporated to dryness and stored at 4 C in the refrigerator for later use. The percentage yield of the petroleum ether leaves extract of *C. dichotoma* was found to be 14 percent w/w on a dry weight basis.

Preparation of ethanol leave Extract of *C.dichotoma*

The material was collected, treated with water to remove any undesired material, and dried in the shade. Crushed *C. dichotoma* leaves that had been air-dried. The crushed leaves were extracted using a hot percolation process utilizing Soxhlet equipment with a solvent ratio of increasing polarity, namely ethanol. To get residue, the extract was evaporated until it was completely dry. Under reduced pressure, these extracts were concentrated. The percentage yield of the ethanolic leaves extract of *C. dichotoma* was discovered to be 15% w/w on a dry weight basis.

Preparation of water leave Extract of *C.dichotoma*

The material was collected, treated with water to remove any undesired material, and dried in the shade. Crushed *c dichotoma* leaves that had been air-dried. The crushed leaves were extracted using a hot percolation method with a Soxhlet apparatus with different solvent ratios of increasing polarity, viz. water. To obtain residue, the extract was evaporated dry. Under reduced pressure, these extracts were concentrated. The percentage yield of *C. dichotoma* water leaves extract was measured on a dry weight basis.

Phytochemical analysis / Phytochemical screening

Phytochemical test – the different extract of leaves of *c. dichotoma* were tested for various components following as-

Test for Carbohydrates

Molisch test

A few drops of 95 percent -naphthol solution in alcohol were added to 2-3 mL of extract. Conc. H_2SO_4 was added from the test tube's sides. The presence of carbohydrates was shown by the appearance of a red-brown ring at the intersection of the liquids [10].

Fehling's solution test

Fehling's A and B solutions were combined in one mL and heated for one minute. An equal volume of extract was added and cooked for 5-10 minutes in a boiling water bath. The presence of carbohydrates was shown by the appearance of yellow and later brick red precipitates.

Benedict's solution test

In a test tube, an equal volume of Benedict's reagent and extract were combined and cooked in a boiling water bath for 5 minutes. The presence of carbs was shown by the brick red color appearance.

Test of alkaloids

Mayers test

Mayer's Reagent Preparation:

This was made by weighing 1.3 g of mercuric iodide and 5.0 g of potassium iodide on a weighing balance and dissolving them in 100 ml of distilled water. 1mL of the extract was placed in a test tube. After that, a 1mL potassium mercuric iodide (Mayer's reagent) solution was added and stirred. The development of a whitish or cream precipitate indicates the presence of alkaloids.

Wagner's test

Iodine combines with the I- ion from potassium iodide to produce I3- ion in Wagner's reagent preparation (brownish solution). The metal ion of K+ will bind as covalent coordinate bonding with nitrogen to alkaloid in Wagner's test, resulting in a complex potassium-alkaloid precipitate.

Wagner's reagent (alkaloids reagent)

Wagner's reagent (alkaloids reagent) is made by Dissolve In 100 mL of water, dissolving 2 g of iodine and 6 g of KI.
Procedure- A few drops of Wagner's reagent were applied to 2-3 mL filtrate. The presence of alkaloids was shown by the appearance of reddish-brown precipitates.

Hager's test

A few drops of Hager's reagent were applied to 2-3 mL filtrate. The presence of alkaloids was shown by the appearance of yellow-colored precipitates[11].

Test of glycosides

Bontrager's test

5–10 ml dilute HCl to 1 gram drug, boil for 10 minutes on a water bath, then filter. The filtrate was extracted with CCl4/benzene and shaken with an equal amount of ammonia solution. Due to the presence of the anthraquinone molecule, the ammoniacal layer takes on a pink or red color.

Modified Bontrager's test

5 mL dilute HCl, followed by 5 mL ferric chloride (5 percent w/v) to 1 gram of drug Boil for 10 minutes on a water bath, cool, and filter. Extract with carbon tetrachloride or benzene, and add an equal volume of ammonia solution, resulting in a pink to crimson color due to the presence of anthraquinone moiety.

Liebermann Burchard test

The drug's alcoholic extract was dried and extracted with $CHCl_3$. A few drops of anhydride were added to the CHCl3 extract, followed by conc. H2SO4 from the test tube's sidewall. The presence of steroid moiety is indicated by the formation of violet to green-coloredrings at the junction of two liquids.

Salkowski test

The drug's alcoholic extract was dried and extracted with $CHCl_3$, with the addition of conc. H_2SO_4 from the test tube's sidewall to the $CHCl_3$ extract. The presence of steroid moiety is formed by the addition of a yellow-colored ring at the junction of two liquids, which turns red after 2 minutes.

Test for Flavonoids

Ammonia test

When filter paper is dipped in an alcoholic solution containing 1 gm of drug sample and then exposed to ammonia vapor, the formation of a yellow mark on the filter paper shows the presence of flavonoid[12].

Shinoda's test

A little amount of sample residue was dissolved in 5 mL ethanol (95 percent w/v) and treated with 0.5 g magnesium metal and a few drops of strong hydrochloric acid. The presence of flavonoids was indicated by the appearance of a pink, crimson, or magenta color within a minute or two.

Lead acetate solution test

A little amount of lead acetate solution was added to the extract. The presence of flavonoids was revealed by the appearance of yellow-colored precipitates.

Test for Phenolic compounds

Each extract's test residue was taken individually in water, warmed, and filtered. The following reagents were used to conduct tests on the filtrate [13].

Ferric chloride test

Ferric chloride was dissolved in 90% alcohol at a concentration of 5% w/v. A few drops of this solution were added to a little amount of the filtrate mentioned above. The presence of phenolic compounds was shown by the appearance of dark green or deep blue color.

Lead acetate test

The test filtrate was mixed with a 10% w/v solution of basic lead acetate in distilled water. The presence of phenolic compounds was confirmed by the appearance of white precipitate.

Potassium dichromate test

When a solution of potassium dichromate was added to the test filtrate, a black color appeared, indicating the presence of phenolic chemicals.

Test for Saponins

Foam test: A few milligrams of the test residue was placed in a test tube with a tiny amount of sodium bicarbonate and water and forcefully agitated. The absence of saponins is indicated by the appearance of foam then stable, like a honeycomb. The presence of Phyto components in the ECD was determined using a standard approach previously published in the literature**.**

Physico-Chemical Evaluation / Physico Chemical Analysis

Ash values -The ash values are determined using three different methods after medicinal plant components are burned: total ash, acid insoluble ash, and water-soluble ash are the three types of ash[14]. Total ash - Its goal is to figure out how much material is remaining after ignition. This contains both "physiological" ash and "non-physiological" ash, which is the residue of external elements adhering to the plant material (such as sand and soil)[15]. After storing leaves of *C. dichotoma* in an oven at 35°C for 24 hours, they were shade dried and mechanically pulverized. Further physiochemical and a phytochemical investigation was performed on these powdered materials. The total Ash value and extractive value were calculated using the procedure indicated in the Indian pharmacopeia of 1960. The extractive value percentages in several solvents (ethanol, petroleum ether, and water) were calculated**.** The powder material (10 g) was precisely weighed before being placed in a crucible. The material was spread out in an even layer and ignited to constant weight by progressively increasing the heat to 500-600 degrees Celsius until it was white, showing the lack of carbon. In a desiccator, the leftover ash was allowed to cool. The total ash concentration (in mg) of air-directed material was determined as follows [16]. % of total ash weight of ash/weight of sample taken x 100

Acid-insoluble ash

After boiling the remaining ash in dilute hydrochloric acid and burning the insoluble materials, this is what's left. The amount of silica in a substance, such as sand or siliceous earth, is determined in this method [17].

METHODS

20 ml of hydrochloric acid was added to the crucible containing the whole ash. It was gently boiled for 5 minutes while covered with a watch glass. The watch glass was washed in 10 ml of hot water before being placed in the crucible. The ashless filter paper was used to capture the insoluble materials, which were then washed with hot water until the filtrate was neutral. The insoluble matter was transferred from the filter paper, dried on a hot plate, and burned to a consistent weight. The residue was weighed immediately after cooling for 30 minutes in a vacuum desiccator. The proportion of ash was estimated using air dried medication as a reference.

Water-soluble Ash: It is the difference in weight between total ash and the residue left after treatment of total ash with water[18]. Method- 25 mL water was added to the crucible containing the whole ash, and it was heated for 5 minutes. The ashless filter paper or a sintered glass crucible were used to collect the insoluble particles. The Ash was weighed after being washed with hot water and burned in a crucible for 15 minutes at a temperature not exceeding 450°C. The weight of this residue was removed from the overall ash weight.

Fluorescence Analysis

On a clean microscope slide, a small amount of dried and finely powdered *C.dichotoma* stem was placed, and 1-2 drops of freshly prepared reagent solution were added, mixed by gently shifting the slide, and allowed to settle for 1-2 minutes. After that, the slide was placed in the UV viewer chamber and exposed to natural light as well as short (254 nm) and long (365m) UV rays [19]. The colors observed with various reagents and radiations were reported.

RESULT AND DISCUSSION

Yield % = wt of dry extract / wt of dry plant * 100

Phytochemical screenings

Qualitative profiling: - Ethanolic extract of *C.dichotoma* was used for qualitative assessment of the major classes of phytochemicals namely flavonoids, alkaloids, carbohydrates, glycosides, etc. The test was performed according to various standard methods[20].The test was based on the visual observation of color change or formation of a ppt after the addition of specific reagents as shown in the following table.

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The author thanks the faculty of pharmaceutical science, Shri Shankaracharya technical campus, Bhilai, C.G, India, for providing the necessary facilities to carry out this work.

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Table 01 - Scientific classification

kingdom	Plantae
Division	Magnoliophyta
Class	Dicotyledons;
Subclass	Astaridae
Order	Lamiales
Family	Boraginaceae;
Genus	Cordia
Species	*Cordia dichotoma Forst*

Table 02 - Physicochemical analysis of *C. dichotoma* leaf

S.No	Parameter	Leaf
2.	Loss on drying	88 %
3.	Total ash drying	12 %
4.	Acid insoluble ash content	5 %
5.	Water-soluble extractive value	1 %
6.	Ph	6.21

Table 03- Phytochemical constituents of *C. dichotoma*

S.No	Parameters	Leaf		
		Water Extract	Pet.Ether 30 ml +Water 70ml extract	Ethanol 80ml+ Water 20 ml extract
1	Alkaloids	+	+	+
2	Carbohydrates	+	+	+
3	Phenol	+	+	+
4	Flavonoids	+	+	+
5	Glycosides	+	+	+
6	Saponin	-	-	-

Table 04 - Test of fluorescence of *C. dichotoma* Leaf

S.No.	Plant + reagent	Light		
		250	350	Visible
1.	1g Leaf Powder + NaOH+ Methanol	Purple	Yellow	Green
2.	1g Leaf Powder +1 N HCL	Yellow	Green	Brown

Figure 01 – *C. dichotoma* plant

Figure 02 - (a) dried plant leaves (b) Extraction Assembly (c) Evaporation process (d) Dried ethanolic extract (e) dried water extract

Figure 03 – shows the extraction process

Figure 4 -a) Molisch test, b) Fehling solution test,c) Benedict's solution test

Figure 05 a) Hager's test, b) Wagner's test and Mayer's test

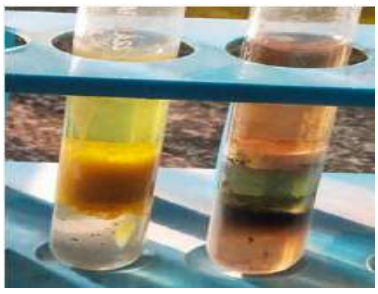

Figure 06 a) Salkowski test, b) Liebermann Burchard test

Figure 07. lead acetate test

Figure 08 - a) ferric chloride test, b) potassium dichromate test

Figure 09. Muffle Furnace

Figure 10. Total Ash

Figure 11. acid-insoluble soluble ash

Figure 12. (A) total ash (Ash + China dish),(B) water soluble ash (ash + China dish), (C) Acid insoluble (ash +China dish)

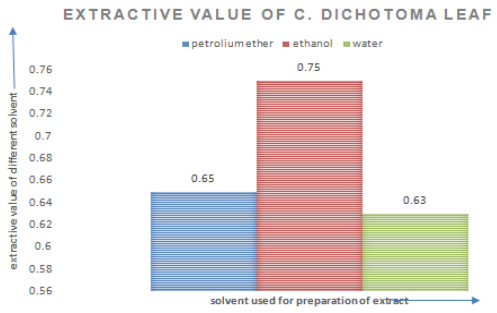

Figure 13.Extractive value of *C.dichotoma* Leaf

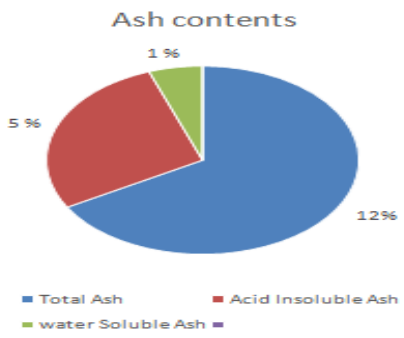

Figure 14. Ash Contents

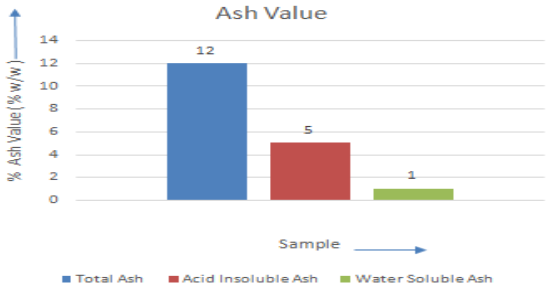

Figure 14. Ash Value

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REVIEW ARTICLE

Review of Schiffs Base Derived Ligands and their Complexes and their Biological Activities

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ABSTRACT

Schiff bases and their structures are versatile compounds that are synthesised by reaction between carbonyl compound and ammonia derivatives . They have a wide range of biological activities, including antibacterial, antifungal, antiviral, antimalarial, anti-inflammatory, anticancer and antipyretic properties. The current study compiles information on a wide range of biological activities and highlights the several Schiff bases that have recently been synthesised as possible bioactive cores.

Keywords: Biological activities, schiffs base, metal complexes etc.

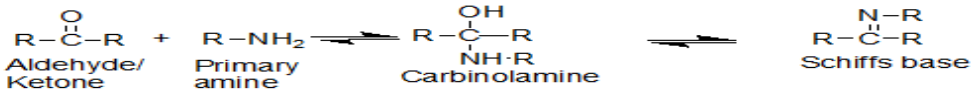
INTRODUCTION

The imine or azomethine (–C=N–) functional group is found in Schiff bases. Hugo Schiff [1–2] described these as the condensation products of primary amines with carbonyl compounds for the first time. Even a century after their discovery in coordination chemistry, Schiff bases played a significant role as ligands [3]. In co-ordination chemistry, Schiff bases are an important class of ligands because of presence of multiple donor atoms [4-5]. Although this issue has been thoroughly explored, Schiff bases, which are formed from the condensation reaction of aromatic/aliphatic aldehydesor ketones and amines and form stable complexes with various transition metal ions, are still relevant to be of significant interest in inorganic chemistry [6]. Schiff bases and their metal complexes have been widely investigated due to their incredible chemical properties and applications in various areas [7-8]. They have been shown to be promising leads for both synthetic and structural research due to their relatively simple synthesis and diversity in structure. They've been utilised as medications, and they've been shown to have a wide range of biological activity against bacteria, fungus, and certain types of cancers. They're also a good model for future

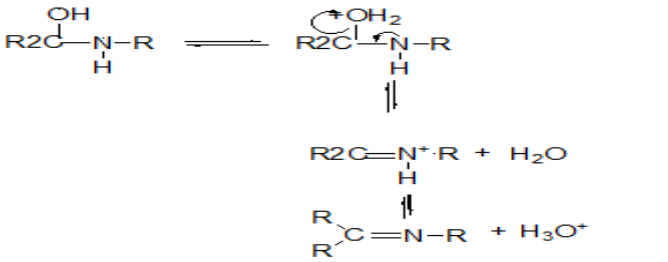
research in [9-10] Bioinorganic Processes. Thiosemicarbazones and thiosemicarbazones are selective inhibitors of ribonucleotidereductase considered as crucial metabolic target for the development of anticancer chemotherapeutics tumor cells. Schiff bases are some of the most usually used organic compounds. They find application in pigments and dyes, catalysts, intermediates in organic synthesis, and as polymer stabilizer[11].

Prepration Of Schiffs Base

A Schiff's base is a type of chemical compounds that contains a carbon-nitrogen double bond as functional group, where the nitrogen atom connected to aryl group or alkyl group (R) but not hydrogen. The Schiff base is synonymous with an azomethine.They are prepared by reaction of carbonyl compounds that is aldehyde or ketone ammonia derivatives as a result C=O is replaced by imine or azomethine group. The formation of a Schiff base from an aldehydes or ketones is a reversible reaction and is generally catalysed by acid or bases or upon heating.
The mechanism for formation of schiffs base is as follows-



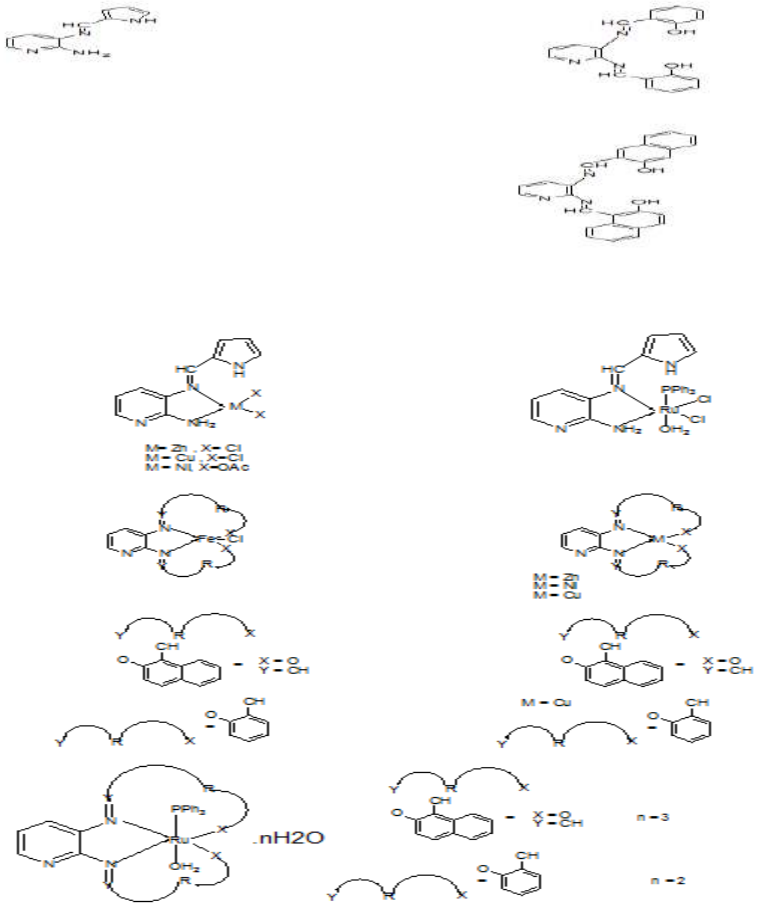
The formation of schiffs base is taken to completion by separation of the product or removal of water, or both. Schiff bases can be hydrolyzed back to their carbonyl part and amines by aqueous acid or base. The mechanism of Schiff base formation is similar toneucleophilic addition to the carbonyl group. where theneucleophile is the amine. During first step of the mechanism, the amine reacts with the aldehyde or ketone to give an unstable addition product called carbinolamine having alcohol and amine group. The carbinolamine losses water by either acid or base catalyzed mechanism. Since the carbinolamine involves alcohol, it can undergo acid catalyzed dehydration easily [12].



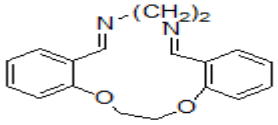
Schiffs Base As Ligand And There Complexes

T. Jeewoth, H. Li KamWahetalreport the preparation of two new Schiff bases derived from DAPY with pyrrole-2-carboxaldehyde (DAPY- { Pyrr}), and 2-hydroxy-1-naphthaldehyde (DAPY-(NaphH}z) and new copper(II), iron(Ill), nickel(II), ruthenium(I1) and zinc(I1) complexes derived from these Schiff bases and the bis-condensed Schiff base DAPY- {SalH}2. These coordinated compounds shows excellent antibacterial properties L against two bacteria, namely Pseudomonas aeruginosa and Salmonella [13].

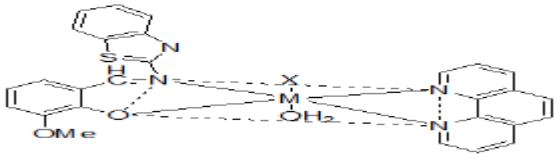
Structure Of Ligand And Complex Formed

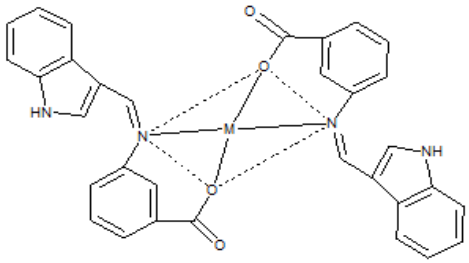


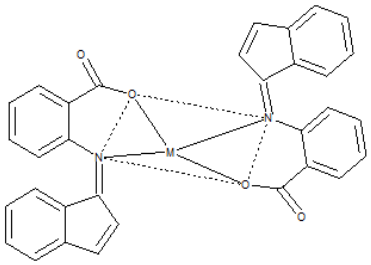
Mostafa M. H. Khalil etal synthesized schiffs base ligand using ethylenediamine in ethanolic solution and bisaldehyde(prepared by using salicylaldehyde) and showed its application for determination of metal ion determination in water sample[14].



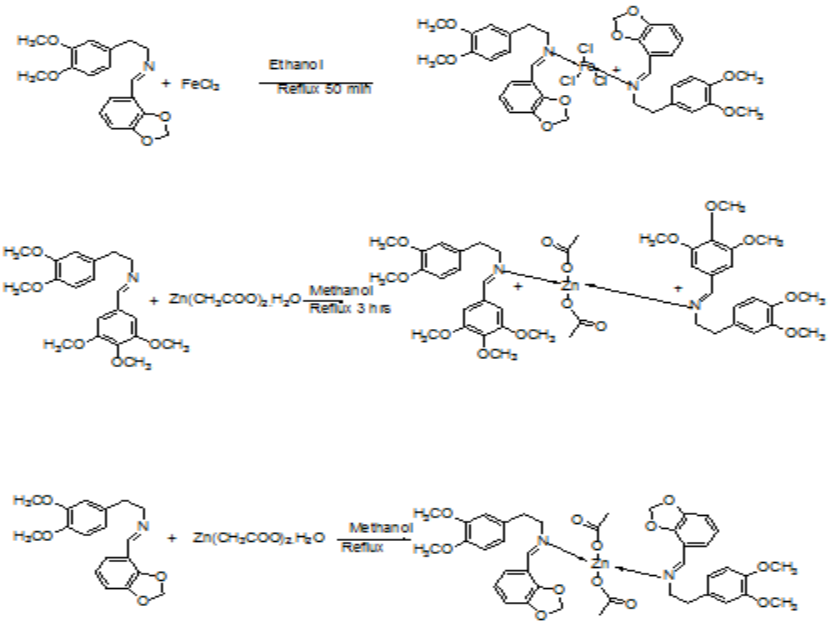
M.A. Neelakantanetal synthesized mixed ligand by the condensation of *o*-vanillin with 2-amino benzothiazole in ethanol (1:1 molar ratio). and mixing 1,10-phenanthroline and its complexes were prepared with Ni,Cu,Mn,Co halides and shown to have antibacterial and antifungal activity[15].







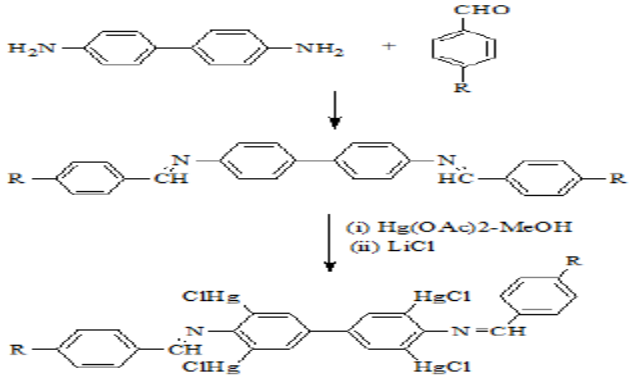
Bushra Naureenetal synthesized schiffs base ligand and form complexes with metal iron and zinc salts these complexes shown to have antibacterialproperties against . Gram-positive (Pseudomonas aeruginosa) and Gram-negative (Escherichia coli, staphylococcus aureus) through agar well diffusion method antifungal properties against e Candida albican (C.albican) and Candida glabrata (C.glabrata) and antioxidant properties.[16]



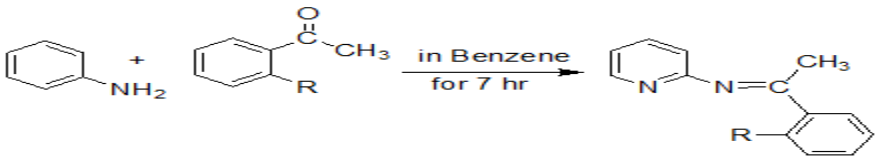
Madhavan SivasankaranNair ,Dasan Arish etal prepare schiifs base ligand using methanolic solution of m-aminobenzoic acid and indole-3-carboxaldehyde. And prepared there complexes with copper,nickel, cobalt,zinc. These complexes shows promising antimicrobial activity against s R. stolonifer, A. niger and C. albicans. And also found to be helpful in vitro DNA cleavage[17].

Ionic liquids vs. Schiff bases supported by ionic liquids

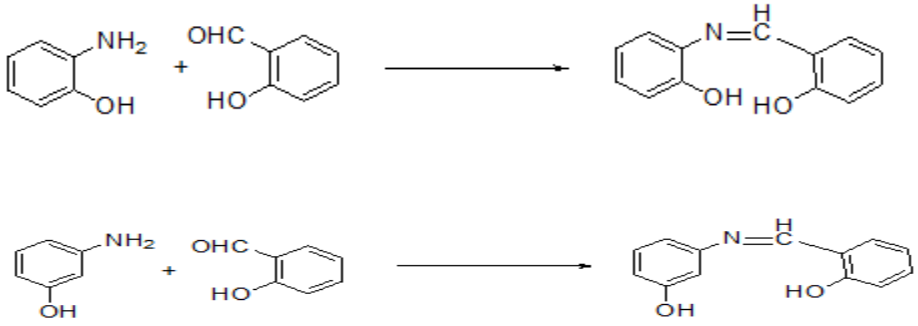
After Ohno's successful production of the tetrabutylammonium salt of amino acids [18], amino acid ionic liquids (AAILs) have gotten a lot of attention in recent years [19–34]. AAILs, like other ionic liquids, are liquid at a wide range of temperatures, have a low vapour pressure, low melting point, good solubility, and thermal and chemical stability [19-22]. Amino acid ionic liquids have been widely employed in the dissolution of biomass such as DNA, cellulose, or polysaccharides, as a gas absorbing medium (CO2 capture), chiral separation, and catalysis . L-amino acids are particularly attractive in the synthesis of chiral ionic liquids because of their natural origin as a low-cost raw material and extensive scope of modification. By changing the cation or anion type [35-37], the amino acid side-chain [38-39], or the amino or carboxyl groups , new groups of amino acid ionic liquids can be created. Bag et al[40] have created a number of benzidene Schiff bases and investigated the mercuration reaction



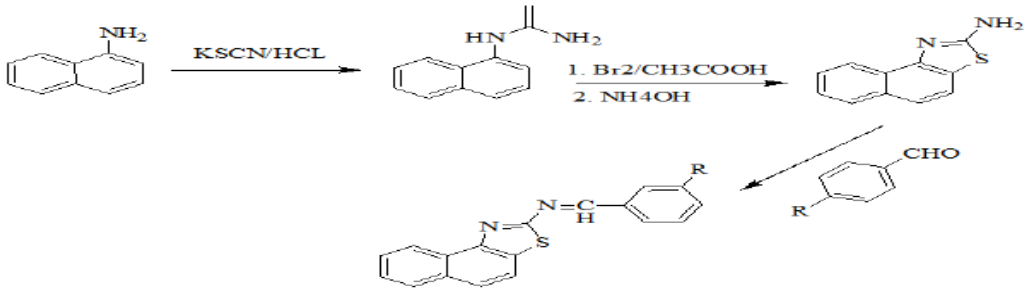
Gudasi *et al* [41] The synthesis, characterisation, and biological investigations of dioxouranium(II) and thorium(IV) Schiff base complexes generated from 2-amino pyridine and acetophenones have been published.



Patil KS et al [42] Cu+2, Ni+2, and Co+2 ions were reported to have mixed ligand transition compounds with Schiff base ligands generated from the condensation of o-hydroxy benzaldehyde with amino phenols and nitrogen donor amine bases. The compounds' antibacterial and antifungal properties were also investigated by the authors.



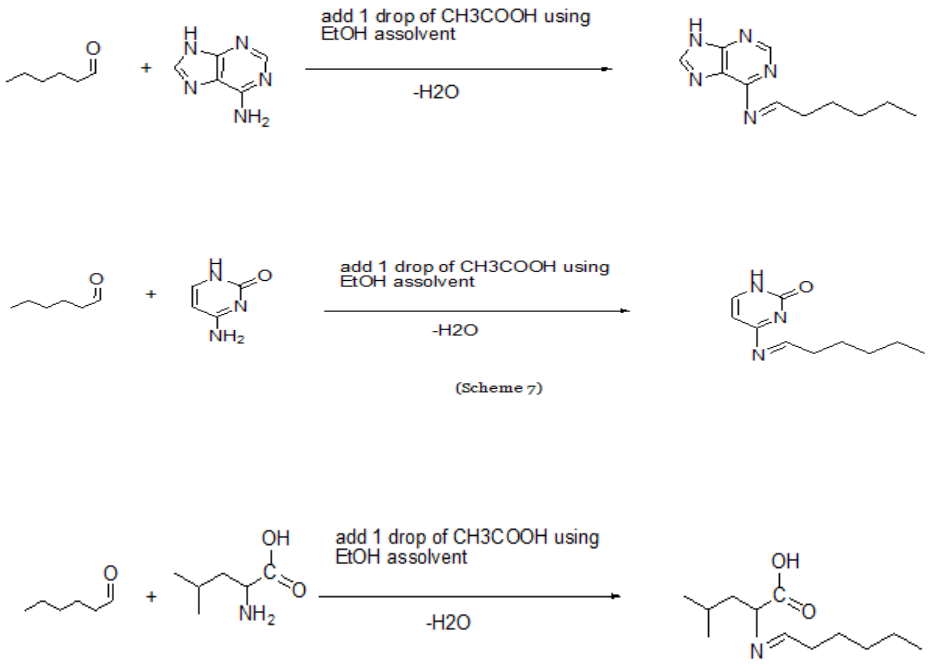
Azam Faizul et al [43] have investigated a series of 2-benzylideneaminonaphthothiazoles that are produced with the lyophilic naphthalene ring to improve their ability to penetrate bio membranes. The findings suggest that Schiff bases with halogen substitutions, hydroxyl groups, and nitro groups at the phenyl ring have good antibacterial activity, whereas methoxy groups at various places in the aromatic ring have a little effect in inhibitory activity.



Biological Activities

Details of the computational research

Gaussian-09 software was used to optimise derivatives of hexanal compounds[44]. Using DFT-B3LYP[45,46].Process and G(2d,p)+ 6-311[47,48]. as a starting point The IR spectra are generated using frequency calculations. We employed TD-DFT with the long-range adjusted CAM-B3LYP function to simulate the UV–visible spectrum[49,50].



(Scheme 7)

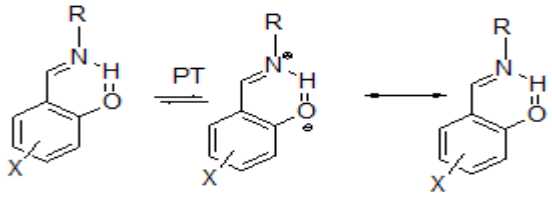
Ionic liquid-supported Schiff bases use Anti-cancer drugs

Cancer is among the most serious human health issues, and it is the second leading cause of death worldwide [51,52]. Cancer has advanced significantly in the modern era, and it is expected to affect 25 million people within next 20 years [52]. Breast cancer is the most common cancer among women worldwide, and it is still the leading cause of mortality among women. It is responsible for approximately 450,000 fatalities worldwide each year [53].

Surgical excision of the tumour or radiotherapy followed by chemotherapy are the current treatment options[54]. Although chemotherapy and radiotherapy are widely used to treat a variety of malignancies, they have a number of drawbacks, including I non-selectivity and damaging side effects on normal cells. (ii) chemotherapeutic drug resistance; and (ii) narrow-spectrum[55]. An unlimited number of researchers have shown tremendous interest in nitrogen- and sulfur-containing heterocyclic compounds for the synthesis of novel biomolecules to enhance their therapeutic potential in pharmaceutical applications throughout the last few decades[56,57]. 2-aminothiazole (AT) and its derivatives, which are found in many natural products, are always attractive bioactive scaffolds for designing and developing different pharmacological medicines with exceptional biological properties[45]. Notably, due to their biological performances in a variety of fields [58], including anticancer efficacy [59], Schiff bases have piqued the interest of numerous pharmacological researchers. Interestingly, the exceptional and amazing physicochemical properties of ionic liquids (ILs) attract many researchers to design numerous smart materials, making them inimitably suited for applications in many fields such as synthesis [60], electrochemistry [61], analytics [62], active pharmaceutical ingredients (API) [63], extraction [64], and so on. Ionic liquid-supported Schiff bases have recently been successfully employed as chemical sensors [65,66] as well as to convert harmful pollutants (primary amines and heavy metal ions) into medicinal candi- dates [67,68].

Equilibrium of proton transport in Schiff bases.

Measurements of deuterium isotope effects on chemical shift are particularly useful in proton transfer equilibrium research. The presence of proton transfer equilibria can be detected using this method, and the mole fractions of tautomers can be determined. For a partially deuterated material, measurements of deuterium isotope effects on chemical shifts can be done in a single tube experiment. Deuterium isotope effects on 13C-NMR chemical shifts were used to identify the position of the proton transfer equilibrium in Schiff bases [69]. Differences between the 13C signals in the spectra of non-deuterated and deuterated species were used to calculate the deuterium isotope effects: $n\Delta C(D) = \delta C(H) - \delta C(D)$.



Highly efficient three component amino acid ionic liquid bound copper Schiff base catalysed reaction

Ionic liquids (ILs) have recently found widespread use in various fields, such as electrolytes in electrochemistry and green reaction media in organic syntheses, due to their unique properties such as higher thermal stability, non-volatility, high solvation power for organic and inorganic compounds, and low flammability[70,71]. for biphasic catalysis [71,73] and immobilising phases Metal-containing ILs, in particular, have been proven to be more toxic. Because they combine the features of ILs with the catalytic properties of the inserted metal salts, task-specific functionalized liquids are promising [74,75]. Ionic liquids with imidazolium ions as the cationic moiety and fluorinated anions such as BF4, PF6 as the anionic counters are commonly utilised [76,77]. Most of these ionic liquids are susceptible to hydrolysis and release HF when exposed to moisture, making them less environmentally friendly. As a result, the development of "truly green" ionic liquids starting from non-toxic and biodegradable precursors is critical from both an environmental and economic standpoint. Following the effective synthesis of amino acids as anions or cations by in 2005 [78], a number of amino acid-based ionic liquids have been developed [79,80].Tea has provided human populations with vitality and passion for ages. It contains a high concentration of tannis and flavonoids which have anticarcinogenic, antimutagenic, and antioxidative properties[81,82]. Phospholipase D (PLD) activity can be regulated by hexanal and inositol, which can be used to keep fruits fresh, reduce weight loss, and retain firmness[83]. However, this substance is harmful to human lung epithelial cells[84]. The detection of excess hexanal in fruit packages has recently been developed using an olfactory-nanovesicle-fused carbon-nanotube-

transistor biosensor (OCB)[27]. Negatively charged amines stabilise Schiffbases[85,86]. Schiff bases are ideal ligands for complexation, catalysis, and synthetic organic chemistry because they may form complexes with a wide range of metal ions[87]. Schiff bases have been discovered to have therapeutic properties in nature. Schiff bases have anti-plasmodial, anti-inflammatory, antioxidant, and antibacterial properties, to name a few[88].

Ionic liquid-supported Schiff bases of amino acids

Ionic liquids (ILs), which are made entirely of ions [89] and are liquid at room temperature [90], have been extensively researched as solvents for various processes. Ionic liquids have a low vapour pressure, which results in lower air emissions, non-flammability, and non-explosiveness [91-93]. In addition, by carefully selecting cations and anions, additional physical properties of ILs including as polarity, hydrophobicity, hydrogen-bond basicity, viscosity, and solvation interactions with organic and inorganic molecules can be precisely regulated [94-98]. A new generation of ionic liquids derived from natural raw materials such as amino acids has recently received a lot of interest. Traditional ionic liquids based entirely on petrochemical raw materials have been replaced by amino acid ionic liquids. Amino Acid Ionic Liquids (AAILs) made from biorenewable raw materials have higher biocompatibility (as measured by their ability to biodegrade in the environment) and reduced toxicity (both ecotoxicity and cytotoxicity) [99,100]. Furthermore, the ability to use amino acid ionic liquid-supported Schiff bases as chiral solvents and catalytic ligands makes this family of molecules particularly attractive. Ionic liquid-supported Schiff bases[101,102], which are derivatives of 1-(2-aminoethyl)-3-methylimidazolium hexafluorophosphate and aromatic aldehydes, have been studied as ligands and solvents for the Pd-catalyzed Suzuki-Miyaura coupling process, yielding good to exceptional biaryl yields [103,119].

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CONCLUSION

The chemistry of Schiff bases is a growing field. Schiff base ligands are preferred ligands because they are easily made from an aldehyde and primary amines in a single pot. These chemicals and their metal complexes had a wide range of applications, including therapeutic, pharmaceutical, and environmental. They have essential roles in catalysts in both analytical and industrial settings. The biological actions of Schiff base and its complexes from 2010 to 2021 have been summarised in this review.

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RESEARCH ARTICLE

De-Sitter Model in $f(R,T)$ Theory of Gravity

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ABSTRACT

In this paper, we have considered a five dimensional Kaluza-Klein metric in presence of perfect fluid in the framework of $f(R,T)$ theory. In particular, we have considered a specific function $f(R,T) = R + 2T$ and using this function, our model reduces to De-setter Universe. The cosmological constant is obtained as liner combination of p and T. The exact solutions of the field equations have been obtained by using the aspect of volumetric expansion. Also, we have studied the behaviour of designed cosmological models in different angles with sense of present epoch.

Keywords: Kaluza-Klien metric, volumetric expansion, perfect fluid, f(R,T) theory.

INTRODUCTION

Universe was the present Universe (the word present universe is used for global structure. After Kaluza's work published in 1921,a natural question was raised where is the 5th dimension. This question is very much relevant as we observe only 4-dimensional world. So, if we believe in a 5-dimensional world, the simplest approach is to think that the extra dimension (5th dimensional) is too small to observe. It indicates that extra dimension should be compact. Evolutions of the universe in cosmological models are based on extrapolation of physical theory whose validity has only been trusted locally. This extrapolation is justified by the principle of general co-variance of relativity theory which states that physical laws are the same at all times & at every space point .When cosmology was taking birth after advent of general Relativity, the only picture of the of the universe around 100 years back also).In the present universe, distance between neighbouring galaxies is $\sim 10^{25}\ c.m.$ Longest galactic diameter is $10^{-23}\ c.m.$ characteristics distance scale of the observable universe is $10^{28}\ c.m.$ It shows that the ratio of the volume

of the longest galaxy to that of the observable universe is 10^{-15} .Thus, a galaxy is extremely small object compared to the universe .Hence cosmologist treat a galaxy as a point like object at cosmic scale. All other cosmic objects are even smaller in size than galaxies. So the entire content of the universe is treated as a non-interacting gas particles behaving like perfect fluid. This gives the homogeneous picture of the universe. The recent observations suggests the observable Universe is homogeneous and accelerating[1]–[5]. The source of this acceleration is being driven by dark energy whose origin is still a mystery in the modern cosmology. To describe the cosmic acceleration, the cosmological constant is the simplest parameter.

In recent years, there has been a lot of interest in constructing dark energy models by many alternative theories such as $f(R,T)$ theory[6], Lyra geometry[7], Chaplygin gas[8]etc. Among these modified theories $f(R)$theory of gravity and $f(R,T)$ gravity are attracting researchers during last decade. Hence, Nowadays the study of $f(R,T)$ theory with Bianchi Models, Kaluza-Klein model, General Relativity are important. Myrzakulov.R have been investigated on f(R, T) theory using FRW metric and studied on the accelerated Universe [9]. Kiran *et al.,* have studied on existence of bulk viscous cosmological model in f(R, T) gravity[10]. Many researchers have studied on f(R, T) gravity using different cosmological models[6], [11]–[15]. [12], [16], [17] have investigated on Kaluza-Klein model using f(R, T) gravity and observed the model in different directions.F.R. Rahman *et al.,* have studied on higher dimensional cosmological model in the context of Lyra geometry [18]. Biswal *et al.,* have discussed on Kaluza-Klein cosmological model in the context of $f(R,T)$ gravity and found in the presence of domain walls[12]. Inspired from the above discussion, we have taken Kaluza-Klein model with perfect fluid description in the context of $f(R,T)$ gravity. To find the exact solution of Einstein field equation,we have assumed a special form of volume. In sect. 2: the field equation of $f(R,T)$ gravity, in sect.3: metric and field equations and their solution and sect. 4 deals with conclusion of the study.

Field equation of f(R, T)gravity

The $f(R,T)$ theory of gravity is a modification of General Relativity. The field equations are derived from the Hilbert-Einstein type variation principle. The action for the modified $f(R,T)$ gravity is

$$S=\frac{1}{16\pi}\int f(R,T)\sqrt{-g}\,d^5x+\int L_m\sqrt{-g}d^5x \quad (1)$$

where$f(R,T)$ is an arbitrary function of Ricci scalar (R) and be the trace of stress–energy tensor T_{ij} of the matter(T).L_m is the matter Lagrangian density. The energy momentum tensor T_{ij} is defined is

$$T_{ij}=-\frac{2}{\sqrt{-g}}\frac{\partial\left(\sqrt{-g}\right)L_m}{\partial g^{ij}} \quad (2)$$

and its trace by $T=g^{ij}\,T_{ij}$ .Here, we assume that the dependence of matter Lagrangian is merely on the metric tensor g_{ij} rather than its derivatives. In this case, we obtain

$$T_{ij}=g_{ij}\,L_m-\frac{\partial L_m}{\partial g^{ij}} \quad (3)$$

The $f(R,T)$ gravity field equations are obtained by changing the action of S with respect to metric tensor g_{ij}.

$$f_R(R,T)R_{ij}-\frac{1}{2}f(R,T)g_{ij}+\left(g_{ij}\nabla^{\mathrm{i}}\nabla_{\mathrm{i}}-\nabla_{\mathrm{i}}\nabla_{\mathrm{j}}\right)f_R(R,T)=8\pi T_{ij}-f_T(R,T)T_{ij}-f_T(R,T)\theta_{ij} \quad (4)$$

Where

$$\theta_{ij}=-2T_{ij}+g_{ij}\,L_m-2g^{\propto\beta}\frac{\partial^2 L_m}{\partial g^{ij}\,\partial g^{\propto\beta}} \quad (5)$$

$f_R(R,T)=\frac{\partial f(R,T)}{\partial R}$, $f_T(R,T)=\frac{\partial f(R,T)}{\partial T}$,Where the ∇_{i} stands for covariant differentiation. Now contraction of equation (4) gives

$$f_R(R,T)R_{ij}-\frac{1}{2}f(R,T)g_{ij}+3\left(\nabla_{\mathrm{i}}\nabla^{\mathrm{i}}\right)f_R(R,T)-2f(R,T)=8\pi T-f_T(R,T)(T+\theta), \quad (6)$$

where $\theta=\theta_i^i$. Equation (4) gives a relation between Ricci scalar R and trace T of energy momentum tensor. Using matter Lagrangian L_m,the stress energy tensor of the matter is given by

$$T_{ij}=(p+\rho)u_iu_j+pg_{ij}, \quad (7)$$

where $u^i = (0,0,0,0,1)$ is the velocity vector in commoving coordinates which satisfies the condition $u^i u_i = 1$and $u^i \nabla_j u_i = 0$.ρ and p are energy density and pressure of the fluid respectively and the matter Lagrangian can be taken as $L_m = -p$.

The stress energy of perfect fluid is

$$\theta_{ij} = -2T_{ij} - pg_{ij} \tag{8}$$

The $f(R,T)$ theory of gravity depending on the nature of the matter source. We take

$$f(R,T) = R + 2f(T). \tag{9}$$

In this paper, we have considered $f(R,T) = R + 2T$.

The gravitational field equation of $f(R,T)$ gravity from equation(4) gives

$$R_{ij} - \frac{1}{2}Rg_{ij} = (8\pi + 2)T_{ij} + (2p + T)g_{ij}. \tag{10}$$

Einstein field equations with cosmological constant is expressed as

$$G_{ij} - \Lambda g_{ij} = -8\pi T_{ij}. \tag{11}$$

From equation (10) and equation(11) we obtained

$$\Lambda = 2p + T. \tag{12}$$

Metric and Field Equations

Consider a five dimensional Kaluza-Klein metric in the form

$$ds^2 = dt^2 - A^2(t)(dx^2 + dy^2 + dz^2) - B^2(t)d\psi^2 \tag{13}$$

Here the fifth coordinate ψ is taken to be space-like and A, B are function of cosmic time t only.

The field equation (10)-(12) for the metric(13) with the help of energy-momentum tensor (7) gives the following system of equations

$$-\frac{A''}{A} - 2\left(\frac{A'}{A}\right)^2 - \frac{A'B'}{AB} + \frac{3}{2}\left(A^3A'' + \frac{A''}{A} + \frac{A'B'(A^4+B^4)}{AB}\right) + 3A^2A'^2 + \frac{1}{2}\left(B^3B'' + \frac{B''}{B}\right) = (8\pi + 2)p - (2p + T), \tag{14}$$

$$-3\left(\frac{B'A'}{AB}\right) + \frac{3}{2}\left(A^3A'' + \frac{A''}{A} + \frac{A'B'(A^4+B^4)}{AB}\right) + 3A^2A'^2 + \frac{1}{2}\left(B^3B'' - \frac{B''}{B}\right) = (8\pi + 2)p - (2p + T) \tag{15}$$

and $\frac{3}{2}\left(\frac{A''}{A} - A^3A'' - \frac{A'B'(A^4+B^4)}{AB}\right) - 3A^2A'^2 - \frac{1}{2}\left(B^3B'' - \frac{B''}{B}\right) = (8\pi + 2)\rho + (2p + T).$ (16)

Adding equation (15) & (16)

$$3\frac{A''}{A} - 3\frac{A'B'}{AB} = (8\pi + 2)(p + \rho) \tag{17}$$

Adding equations (14) & (16)

$$2\frac{A''}{A} - 2\left(\frac{A'}{A}\right)^2 - \frac{A'B'}{AB} + \frac{B''}{B} = (8\pi + 2)(p + \rho). \tag{18}$$

Subtracting (18) from (17)

$$\frac{A''}{A} + 2\left(\frac{A'}{A}\right)^2 - 2\frac{A'B'}{AB} - \frac{B''}{B} = 0. \tag{19}$$

Where an overhead prime denotes ordinary derivative with respect to cosmic time 't' only.

Rewriting the equation (19) is of the form

$$\frac{d}{dt}\left(\frac{A'}{A} - \frac{B'}{B}\right) + \left(\frac{A'}{A} - \frac{B'}{B}\right)\frac{V'}{V} = 0. \tag{20}$$

Here we considered the spatial volume

$$V = A^3B. \tag{21}$$

Integrating both side of equation(20) w.r.to. t we get

$$\frac{A}{B} = c_2 e^{c_1 \int \frac{dt}{V}}. \tag{22}$$

Using equation (21) & (22) the metric potentials can be represent as

$$A = c_2^{1/4} V^{1/4} e^{c_1/4 \int \frac{dt}{V}} \quad (23)$$

and

$$B = c_2^{-3/4} V^{1/4} e^{-3c_1/4 \int \frac{dt}{V}}. \quad (24)$$

The directional Hubble parameters along different directions are defined as

$$H_x = H_y = H_z = \frac{A'}{A} \& H_\psi = \frac{B'}{B}.$$

To treat the metric potentials in a physically realistic way, here we have considered the volume of the Universe as a power law form i.e.

$$V = A^3 B = t^b e^{kt} \quad (25)$$

Here we took $b = 0$, which covers all possible expansion histories throughout the evolution of the universe. The positive nature of the exponent is in accordance with observational findings predicting an expanding universe. The power law expansion of the universe predicts a deceleration parameter $q = \frac{a\ddot{a}}{(\dot{a})^2}$, where a stands for the average scale factor of the universe and is related to the directional scale factors A & Bthrough $a = (A^3 B)^{\frac{1}{4}}$.

The directional scale factors can be obtained by using (25) in (23) & (24) as

$$A = c_2^{\frac{1}{4}} (e^{kt})^{\frac{1}{4}} e^{\frac{c_1}{4}\left(\frac{e^{-kt}}{-k}\right)}, \quad (26)$$

$$B = c_2^{-\frac{3}{4}} (e^{kt})^{1/4} e^{\frac{-3c_1}{4}\left(\frac{e^{-kt}}{-k}\right)}, \quad (27)$$

$$H_x = H_y = H_z = \frac{1}{4}k + \frac{c_1}{4}(e^{-kt}), \quad (28)$$

$$H_\psi = \frac{1}{4}k - \frac{3c_1}{4}(e^{-kt}) \quad (29)$$

$$and \qquad H = \frac{3H_x + H_\psi}{4} = \frac{k}{4}. \quad (30)$$

The directional Hubble parameters in respective directions are

$$H_x = H_y = H_z = H + \frac{c_1}{4}(e^{-kt}) \quad (31)$$

and $H_\psi = H - \frac{3c_1}{4}(e^{-kt})$. (32)

The anisotropy parameter Δ is

$$\Delta = \frac{1}{4}\sum_{i=1}^{4}\left(\frac{(H_i - H)}{H}\right)^2 = \frac{3c_1^2 e^{-2kt}}{k^2}, \quad (33)$$

where $H_i (i = 1,2,3,4)$ represent the directional Hubble parameters in the directions of x, y, z & ψ respectively.

The expansion scalar $\theta = 4H = k$ (34)

and the shear scalar $\sigma^2 = \frac{3}{8}c_1^2 e^{-2kt}$. (35)

The other unknowns are obtained as follows

$$P = \frac{3}{4\alpha(2\alpha+3)}[(\alpha+1)c_1^2 e^{-2kt} + \alpha k^2], \quad (36)$$

$$\rho = \frac{3}{4\alpha(2\alpha+3)}(c_1^2 e^{-2kt}(\alpha+2) - \alpha k^2), \quad (37)$$

and $\Lambda = -\frac{3}{8(2\alpha+3)}\left[c_1^2 e^{-2kt} + 3k\left(k+\frac{c_1}{2}\right)e^{-kt}\right]$ (38)

The equation of state $\gamma = \frac{p}{\rho} = \frac{\left((\alpha+1)c_1^2 e^{-2kt} + \alpha k^2\right)}{(\alpha+2)c_1^2 e^{-2kt} - \alpha k^2}$. (39)

Case-I: $\gamma = 0$ (Dust Model)

For $\gamma = 0$ *we get* $p = 0$. (40)

Case-II:$\gamma = 1$ (Stiff Fluid)

For $\gamma = 1, p = \rho$ (41)

$\Rightarrow c_1^2 = 2\alpha k^2 e^{2kt}$. (42)

The deceleration parameter $q = a\frac{\ddot{a}}{(\dot{a})^2} = 1$. (43)

The jerk parameter $j = \frac{1}{H^3}\left(\frac{1}{a}\frac{d^3a}{dt^3}\right) = 1$. (44)

Physical behaviour of the model

In figures 1 and 2 we have plotted the time evolution of pressure and energy density. It is observed from figure 1, Pressure assumes negative values throughout the evolution of cosmic time and it increases from a large negative pressure to small value at a later epoch. On the other hand, the energy density decreases for some large positive value in the initial epoch to very small values in later times. Fig.1 describes as the variation of pressure versus comic time. It is observed that the pressure of the model diverges during the explosion and later on it increases to a small positive value. It is also depicts that the pressure remains negative throughout the evolution which indicates the universe accelerate with pressure. Fig.2 gives the energy density versus cosmic time. Here one can observe that the energy density gives exactly opposite result to the pressure of the model. The pressure and energy density of the model gives a valid result that fit to the recent astronomical data. Fig.3. indicates the EoS for the modeled universe diverges initially and later on approaches to -1 which is the expected result for an accelerating universe. Here we noticed that the cosmological constant remains positive throughout the cosmic evolution.

CONCLUSION

In this paper, we have studied on five dimensional Kaluza-Klein metric in the context of $f(R,T)$ theory. The exact solution is obtained by taking a special power law form of volume. The Pressure, Energy density and cosmological constant are represented geometrically and observed that all the cosmological terms initially diverging during the period of cosmic explosion which is regarded as the well known Big-Bang Singularity. The pressure is remain negative during entire evolution which indicates for an accelerating Universe. The energy density is obtained as positive in entire evolution as expected. The cosmological constant is positive initially and later it behaves as decreasing function of time. Finally it reduces to a very small value that approaches to zero. During the Big-Bang the EoS remain negative and later on it approaches to -1. Hence, we conclude that our obtained model reduces to De-Sitter Universe at late time.

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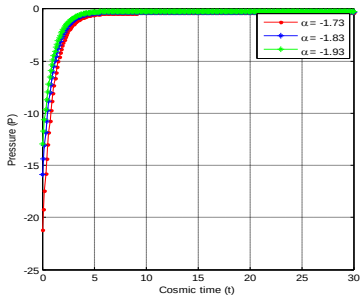

Fig.1: Represents the variation of Pressure versus cosmic time t.

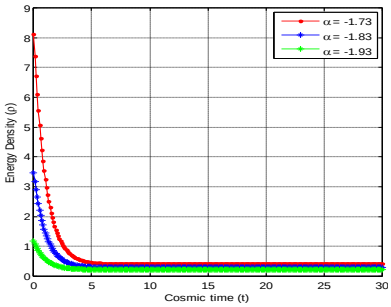

Fig.2:Represents the variation of Energy Density versus cosmic time t.

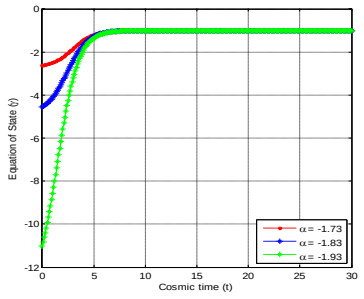

Fig.3:Represents the variation of Equation of State parameter(γ) versus cosmic time t.

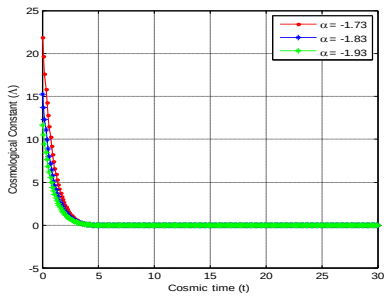

Fig.4: Represents the variation of Cosmological Constant(Λ) versus cosmic time t.

RESEARCH ARTICLE

Evaluation of the Shodhana (Processing) Effect on Gauripashana (Arsenic Trioxide) by Physicochemical Characterization

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ABSTRACT

Medicinal values of arsenic compounds have been well documented in Ayurvedic system of medicine. Gouripashana (Arsenic Trioxide) is one such arsenic compound which is being used for many diseases after the detoxification process known as Shodhana. This study was conceptualized to evaluate the shodhana effect on Gouripashana by physicochemical characterization. The present study was carried out to evaluate and compare the differences in the physicochemical properties of Shodita (Processed) and Ashodita (Unprocessed) Gouripashana. Gouripashana was processed as per classical reference and the samples were subjected to Physicochemical analysis like- X-RD, DLS, FTIR, SEM - EDX, TEM, AFM and Raman Spectroscopy. XRD showed crystallite size of the compound is decreased after Shodhana. In DLS data, marginal reduction in particle size after Shodhana could be appreciated. FTIR spectrum revealed the presence of organic peaks in processed sample. In SEM-EDAX, weight percentage of Arsenic is reduced and weight percentage of Oxygen is increased after Shodhana, which is indicative of increased organic nature of Gouripashana after shodhana. TEM studies showed amorphous materials in processed Arsenic, which may be due to organic content imparted from the medium. Reduction in Arsenic level and increase in organic nature indicates possibility of reduction in toxicity. Physicochemical evaluation of both samples was not having much variation. Analysis suggested that particle size is reduced, which

increases the bio availability, also better stability of the crystals and increased organic nature were observed after processing which might help in reducing the toxicity of the drug.

Keywords: Gouripashana, Arsenic Trioxide, Shodhana, Analytical study, toxicity

INTRODUCTION

Rasashastra deals with Rasaushadhis and their pharmacology, it incorporates drug designing and analyzing with vision to produce a safe drug through various processing. Shodhana is one such process done to convert inorganic materials to organic compound for better absorption, assimilation, reduce toxicity and to enhance the medicinal properties[1]. The Arsenical compounds have a long and remarkable history of pharmacological utilities and traditional practices[2]. Various side effects of these Arsenic compounds have been listed in Rasashastra texts if they are used without proper shodhana. So advised for mandatory processing of shodhana before its usage. Gouripashana is purified by placing it inside the pouch of cloth, hanging it in the pot filled with the milk and steamed[3].There have been increased numbers of case reports being published of toxic metals poisoning such as Lead, Mercury and Arsenic after the use of Ayurveda remedies[4,5] which created a negative impact on public for the use of Ayurveda medicine[6]. In spite of many research works regarding the safety and efficacy of preparations of metals and minerals, these are always under debate, regarding its usage. This is largely because of ignorance about the rationality of the methods of processing adopted in the preparation of these dravyas. These preparations pass through a laborious and tedious process of shodhana, bhavana, marana, and many others which have their impact in making these metals and minerals safe for therapeutics. Analytical profile will also help for the standardization and to assess the physicochemical changes which occurred after Shodhana in the processed product. Concepts of Rasa shastra needs to be upgraded and validated using the scientific and technological advances, with regarding to drug processing. So, attempt to analyze the physical and chemical modifications that Arsenic compounds possibly undergoes after processing and establishing their safety profile will be done in this study.

MATERIALS AND METHODS

Shodhana of Arsenic compounds

The genuine raw drug of Gouripashana was procured and subjected to their methodological shodhana (processing) as per the classical reference in the teaching Pharmacy of our institution.

Physicochemical characterization

- Analysis of Gouripashana was done before processing and after processing
- Physicochemical analysis was done at Ganesh consultancy & Analytical services, Mysuru
- Other instrumental analysis- X-Ray Diffraction (X-RD), Dynamic Light Scattering (DLS), Fourier-transform infrared spectroscopy (FTIR), Scanning electron microscope (SEM)- Energy dispersive X-ray (EDX) analysis, Transmission electron microscope (TEM), Atomic force microscope (AFM), and Raman Spectroscopy were done at Indian institute of science, Bangalore.

RESULTS

Physicochemical analysis

Physicochemical analysis showed- after Shodhana, the pH of the drug has changed from 4.55 to 4.6, slight increase in Total ash value, mild decrease in acid insoluble and water insoluble ash, slight decrease in loss of drying and loss of ignition Percentage.

X ray diffraction(XRD) study

Sample 1showed 43 peaks out of which 27 are characterized as As2O3. Sample 2 showed 41 peaks out of which 26 are found to be of As 2O3. There are no major differences among the compounds observed in the samples except for the crystallite size. It seems that crystallite size of the compound has decreased after Shodhana. e.g., In sample 1 peak with 2-theta(deg) 12.494, d spacing 7.0788 and FWHM (deg) 0.082 showed the crystallite size of 101.83 nm whereas in sample 2 similar peak with 2-theta(deg) 12.48, d spacing 7.085 and FWHM (deg) 0.12 showed the crystallite size of 69.58 nm. In sample 1 peak with 2-theta(deg) 13.830, d spacing 6.3982 and FWHM (deg) 0.084 showed the crystallite size of 99.54 nm whereas in sample 2 similar peak with 2-theta(deg) 13.8222, d spacing 6.4016 and FWHM (deg) 0.090 showed the crystallite size of 92.90 nm. In sample 1 peak with 2-theta(deg) 22.419, d spacing 3.962 and FWHM (deg) 0.09 showed the crystallite size of 94.02 nm whereas in sample 2 similar peak with 2-theta(deg) 22.43, d spacing 3.961 and FWHM (deg) 0.14 showed the crystallite size of 60.44 nm. In sample 1 peak with 2-theta(deg) 27.8767, d spacing 3.1979 and FWHM (deg) 0.36 showed the crystallite size of 92.86 nm whereas in sample 2 similar peak with 2-theta(deg) 27.875, d spacing 3.1980 and FWHM (deg) 0.120 showed the crystallite size of 71.27 nm.

Dynamic Light Scattering (DLS) study

Sample 1 showed 60535.3 nm (mean diameter 9989.7 nm) as an average effective diameter of particles in three runs whereas sample 2 showed 41,607.6 nm (mean diameter 3082.4 nm).as an average effective diameter of particles. Dispersity of sample 1 is 0.005 and that of sample 2 is 0.703.

Fourier transfer infrared(FTIR) study

A peak with position 3674.37 and intensity 98.97% is unique for Sample 1. A peak with position 3400.83 and intensity 97.88% and another peak with position 1260.10 with intensity 78.92% are unique for Sample 2. In Sample 1 (Unprocessed Gouripashana), the first peak represents the presence of OH-NH stretch. In sample 2 (Processed Gouripashana), 1st peak shows the presence of Amines group with Nitrogen & Hydrogen bond (N-H) with medium, stretch bonding pattern. In the same sample 2, peak 3 shows Alcohols / Ethers /Carboxylic acids /Esters group with c=o bond, strong, stretched bonding pattern. 4th and 5th peak in sample 1 and 5th peak in sample 2 probably indicate Alcohols/Ethers/Carboxylic acids /Esters group c=o bond with strong, stretched bonding pattern. 6th peak in both the samples shows Alkenes group with c=c bond, strong, bend bonding pattern. Inorganic sharp peaks of areolate are observed between 400 and 800 cm-1 in both the samples.

Scanning electron microscopy(SEM) study

SEM reports shows that Surface of particle is rough & uneven. Both the samples 1 and 2 shows porous nature of particles of size >1μm. Particles have sharp edges, showing crystalline nature. But In sample 2 amorphous materials are also seen. EDX analysis concludes that the presence of only two elements. It is observed that average weight % of As Sample 1 is 73.30 and in sample 2, it is 71.90%. On the other hand, average weight % of oxygen in Sample 1 is 26.70% and in sample 2, it is 28.10.

Transmission electron microscope (TEM) study

TEM studies showed crystallites forming agglomerates above 1 micron size. Individual crystal is nano sized varying from 5 nm to 500 nm in size. A few of them appear like cubic and tetrahydro in structure. In processed Gouripashana, the average size of the crystals is reduced and amorphous materials are also seen.

Atomic force microscope (AFM) study

The surface of the sample 1 appears to be rougher with a smaller number of spheres. The surface of sample 2 is comparatively smooth and the spheres are uniform.

Raman Spectroscopy study

Figure 11. Raman Spectroscopy report of Unprocesse d Gouripashana (Sample 1), Figure 12. Raman Spectroscopy report of Unprocessed Gouripashana (Sample 2)

DISCUSSION

Our ancient scholars of Alchemy were much aware of impurities present in the metals and minerals and their adverse effects on their administration. While explaining them in classic literature, they have explained the side effects of unprocessed metals and minerals and described the methods of processing to overcome such untoward effects. Hence, the science of Alchemy strictly recommends that these drugs should be administered after suitable processing. Shodhana (Purification) is one such process which has several objectives like elimination of Physical & Chemical impurities; Neutralization of toxins; To induce and enhance therapeutic qualities; To impart Organic qualities; modification of undesirable physical properties of the drug; alteration of some of the characteristics of the drug and many others. In this study, shodhana of the drug Gouripashana was done as per the classical references and the physicochemical changes happened by this process was noted by subjecting the Unprocessed and Processed Gouripashana to various analysis. Physicochemical analysis is the important characteristics to evaluate the quality, standardization and safety of Ayurvedic drugs and provide information about correct identification and authentication of the raw drugs & formulations and may help in preventing its adulteration. In this study, Physicochemical analysis were done which includes pH value, Total Ash, Acid insoluble ash, Water insoluble ash, Loss on drying at $110^0$and Loss on ignition. The pH conventionally represents the acidity and alkalinity.

The pH of the drug has changed from 4.55 to 4.61 after shodhana due to the effect of milk used for the shodhana which is the weak acid having the pH 6.7 to 6.9. The ash content of a sample is a measure of the amount of inorganic noncombustible material it contains[7]. Ash values are important quantitative standards and criterion to analyze the identity and purity of crude drugs. Ash value of the Unprocessed drug is 0.20% and that of processed drug is 0.27%. The slight increase in Ash value may be due to the addition of non-combustible inorganic component of shodhana medium, but Ash value of both the samples are within the normal limits signifying their purity and standard. Acid insoluble ash is a part of total ash and measures the amount of silica present, especially sand and earth. After Shodhana, there is mild decrease in acid insoluble and water insoluble ash suggesting the purity of the drug. The loss on drying at 110°C is a physical test to determine the percentage of moisture content and hence the shelf life of the sample. In the present study, processed Gouripashana was found to exhibit a loss on drying of 0.056% and that of unprocessed Gouripashana is 0.060%. This mild reduction in loss of drying shows that processed drug is comparatively more stable as it has low moisture content and so a very low probability of allowing bacterial and fungal growth. Loss on ignition describes the process of measuring the weight change of a sample after it has been heated to high temperature causing some of its content to burn or to volatilise[8]. Arsenic is highly volatile and sublimates easily into air. Loss of ignition of processed Gouripashana is 99.73% and that of unprocessed Gouripashana is 99.8%. It shows that after shodhana the drug is more stabilized. X-ray powder diffraction (XRD) is a rapid analytical technique primarily used for phase identification of a crystalline material and can provide information on unit cell dimensions[9]. In this study, the data's obtained from the XRD analysis of the sample before and after purification confirms the presence of Areolate (As2O3) and it was justified with the diffraction pattern of standard reference matching materials which confirm the genuinity of the drug.

The peak intensity of Sample 2(processed Gouripashana) is more when compared to Sample 1 (unprocessed Gouripashana) which indicates good crystallinity after shodhana. Also, XRD showed crystallite size of the drug is decreased after Shodhana Dynamic Light Scattering (DLS) is an analytical technique used to measure the particle size distribution of formulations and it has been used to measure the particle size of dispersing colloidal samples[11]. In the present study, DLS data reveals Marginal reduction in particle size after Shodhana. And also, it is observed that the crystallinity and dispersity had increased after shodhana. Particle size is one of the factors which will affect dissolution and absorption of drug. Particle size and surface area are inversely proportional to each other, as particle size decreases surface area increases. This leads to increase in dissolution of drug and rapid absorption is measure of rate of solution. Fourier transform infrared spectroscopy (FTIR) is widely used for the analysis of both organic and inorganic compounds. It can confirm the composition of solids, liquids, and gases[10]. In this study, FTIR reports

shows that no major differences were observed among the peaks in processed and unprocessed samples. But FTIR spectrum revealed the presence of organic peaks in processed sample. There are slight changes in the peaks which reveals that it contains Organic Compounds with functional groups after purification. This is due to the drug processed in organic compound medium. The reports confirm the shodhana process impart organic quality to the drug. Scanning electron microscope (SEM) provides detailed high-resolution images of the sample and An Energy Dispersive X-Ray Analyzer (EDX) is used to provide elemental identification and quantitative compositional information. It is observed in the present study that weight percentage of Arsenic is reduced after Shodhana and weight percentage of Oxygen is increased after Shodhana. It shows that after shodhana, oxygen content is increased which is indicative of increased organic nature of Gouripashana. Reduction in arsenic level indicates possibility of reduction in toxicity. Transmission Electron Microscope (TEM) provide topographical, morphological, compositional and crystalline information. The images allow researchers to view samples on a molecular level, making it possible to analyze structure and texture. Transmission Electron Microscope images of both the samples show nano sized crystals varying in size. In processed Gouripashana, the average size of the crystals is reduced and amorphous materials are also seen. In sample 2, crystallites forming agglomerates where in sample 1, it is clear may be due to reduction in particle size and influence of organic material from the medium. In processed Arsenic, amorphous materials are also seen which may be due to organic content imparted from the medium. Atomic force microscope (AFM) offers both qualitative and quantitative information on many physical properties including size, morphology, surface texture and roughness. The surface of the sample 1 appears to be rougher with a smaller number of spheres. The surface of sample 2 is comparatively smooth and the spheres are uniform. This shows the increased stability of the processed drug. The rough surface has a direct impact on the organic receptiveness of the material as it affects the water quantity that can be stored on the material surface, thus affecting the bio receptivity of the material accordingly indicates more receptivity for adsorption In Raman's spectroscopy, no major differences can be appreciated in 2 samples. But the intensity of the peak has increased in sample 2 may be because of addition of organic compounds.

CONCLUSION

Physicochemical evaluation of both samples were not having much variation. There are only minor changes in the physico-chemical parameters of Gouripashana after being subjected to Shodhana by steaming in milk medium. However, Analysis suggested that particle size is reduced, which increases the bio availability, also better stability of the crystals and increased organic nature were observed after processing which might help in reducing the toxicity of the drug.

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CONFLICT OF INTEREST

The authors have no conflicts of interest regarding this investigation.

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Table 1 showing the reports of Physicochemical analysis of Unprocessed (Sample 1) and Processed (Sample 2) Gouripashana

Sl. No.	Test	Sample 1	Sample 2
1	pH value (1% solution)	4.55	4.61
2	Total ash	0.20%	0.27%
3	Acid insoluble ash	0.10%	0.079%
4	Water insoluble ash	0.16%	0.12%
5	Loss on drying at110^0	0.06%	0.056%
6	Loss on ignition	99.8%	99.73%

Table 2: Values of FTIR report of processed Unprocessed Gouripashana (Sample 1)

Peak no.	Position cm^{-1}	Intensity%
1.	3674.37	98.97
2.	1337.07	96.27
3.	1161.01	96.57
4.	1059.98	90.41
5.	1050.42	62.53
6.	800.63	5.19
7.	478.32	28.39

Table 3: Values of FTIR report of processed Gouripashana (Sample 2)

Peak no.	Position cm^{-1}	Intensity%
1.	3400.83	97.88
2.	1336.93	89.17
3.	1260.10	78.92
4.	1161.28	91.10
5.	1050.38	37.35
6.	799.68	32
7.	478.5	7.13

Table 4: Values of FTIR report of Unprocessed Gouripashana (Sample 1)

Element	Weight%	Atomic%
O K	26.70	63.04
As L	73.30	36.96
Totals	100.00	

Table 5: Values of FTIR report of processed Gouripashana (Sample 2)

Element	Weight%	Atomic%
O K	28.10	64.67
As L	71.90	35.33
Totals	100.00	

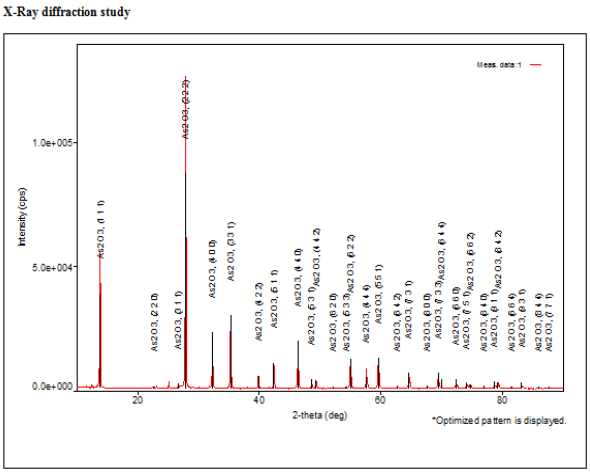

Figure 1: XRD report of Unprocessed Gouripashana (Sample 1)

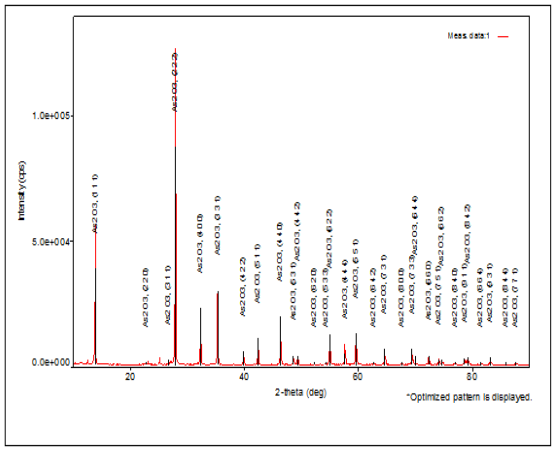

Figure 2: XRD report of Processed Gouripashana (Sample 2)

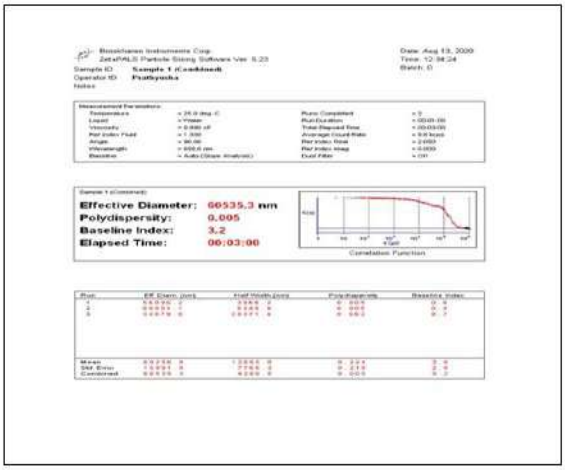

Figure 3. DLS report of Unprocessed Gouripashana (Sample 1)

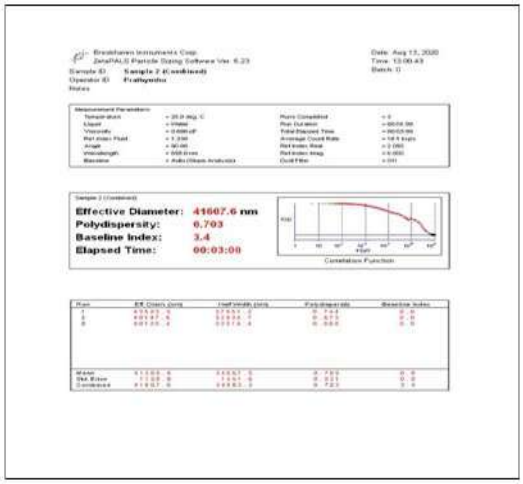

Figure 4. DLS report of processed Gouripashana (Sample 2)

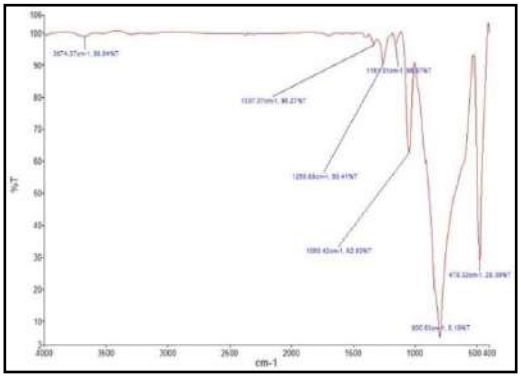

Figure 5. FTIR report of unprocessed Gouripashana (Sample 1)

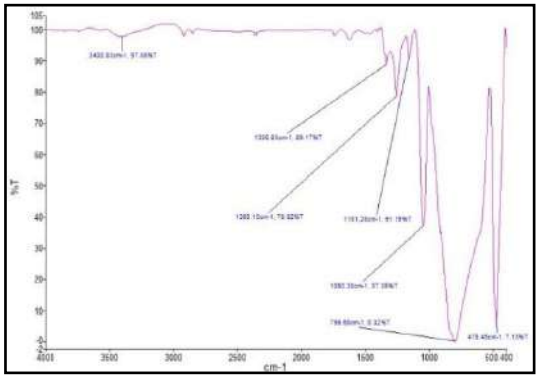

Figure 6. FTIR report of processed Gouripashana (Sample 2)

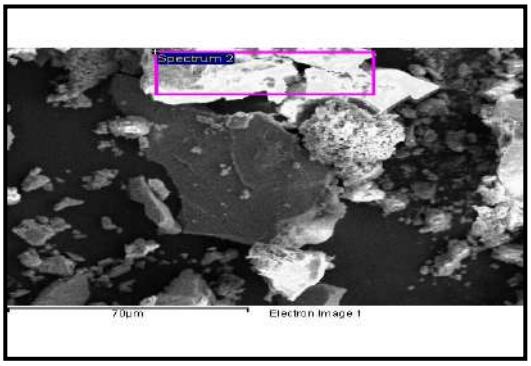

Figure 7. SEM of Unprocessed Gouripashana (Sample 1)

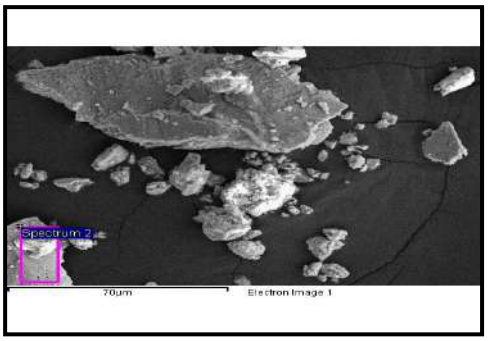

Figure 8. SEM of Processed Gouripashana (Sample 2)

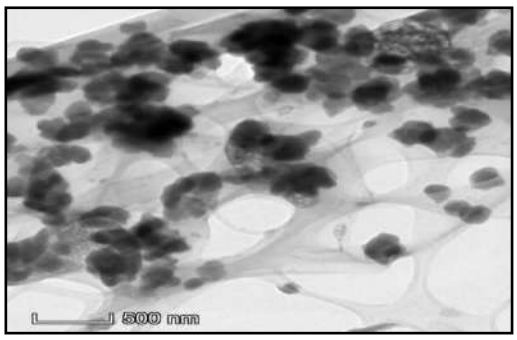

Figure 9. TEM of Unprocessed processed Gouripashana (Sample 1)

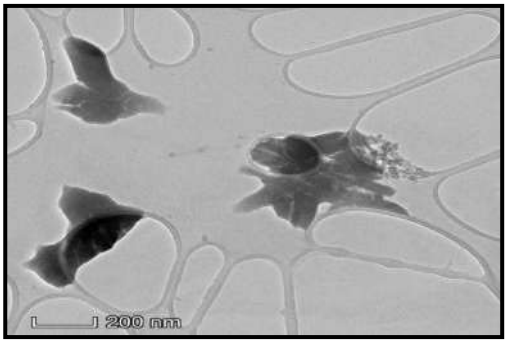

Figure 10. TEM of Processed Gouripashana (Sample 2)

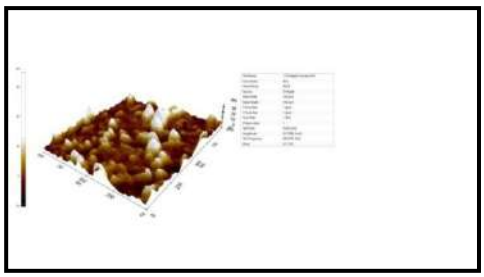

Figure 11. AFM of Unprocessed Gouripashana (Sample 1)

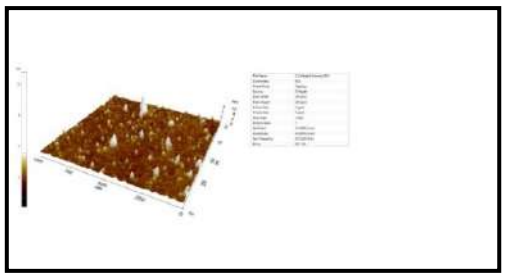

Figure 12. AFM of processed Gouripashana (Sample 2)

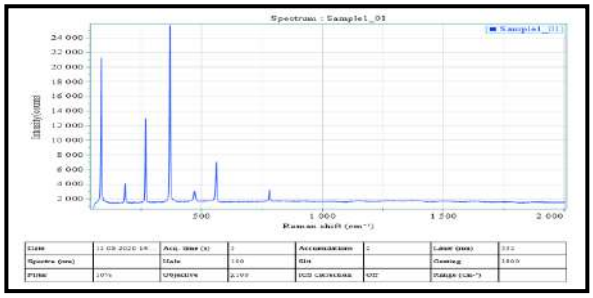

Figure 13. Raman Spectroscopy report of Unprocessed Gouripashana (Sample 1)

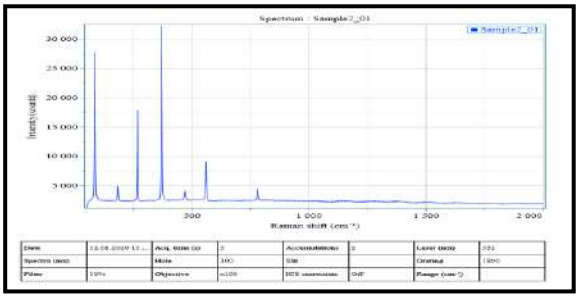

Figure 14. Raman Spectroscopy report of Unprocessed Gouripashana (Sample 2)

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RESEARCH ARTICLE

Effect of Gamma Rays on Growth and GC-MS Analysis in Bhindi [*Abelmoschus esculentus* (L.) Moench]

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ABSTRACT

The present research work was carried out to know the influence of gamma rays on bhindi cv-Arka anamika. The uniform and viable seeds of Arka anamika were exposed to different doses of gamma irradiation like 100, 200, 300, 400, 500 and 600Gy.The irradiated seeds had sown in the field to measure the various growth parameters, such as germination, survival, plant height, internodal length and number of leaves per plant were observed in control and treated population. The growth parameters decreased with the doses of gamma rays increased. The GC-MS analysis had proceeded out in control and gamma rays treated plants of M_1 generation. In control totally eighteen phytochemical constituents were noticed. There was a decreasing number of phytochemicals with increasing gamma irradiation. Only five phytochemical constituents were present among all the treated leaves control included, but there were a few significant phytochemical compounds found only in 100Gy, 200Gy, 400Gy and 500Gy which were not found in control.

Keywords: Bhindi, [*Abelmoschus esculentus* (L) Moench], Gamma irradiation, Growth parameters, GC -MS analysis.

INTRODUCTION

The genus Abelmoschus , belongs to the family of Malvaceae is represented by 12 species in which the most common vegetable crop is okra [1]. Okra is known as lady's finger [*Abelmoschus esculentus* (L) Moench] and it is a warm season flowering plant cultivated throughout the tropical and warm temperate regions in worldwide [2].Okra [*Abelmoschus esculentus* (L.) Moench] is generally taken as fresh vegetable or cooked dish by boiling or frying and even used in soups and stews too [3]. It contain high nutrional values like calcium phosphorus, protein, carbohydrate, fat and some amount of vitamins [4]. The yellow vein mosaic disease, the virus transmitted disease is the common factor influences the cultivation of okra plant, which spread by white fly (*Bemisia tabaci*) [5].The conventional breeding methods are employed mostly for the improvement of crops and natural variability in the germplasm. Induced mutagenesis an alternative method to overcome this complication to create variability in different quantitative traits [6]. Gamma radiation has been widely used for mutation induction for both seed and vegetative propagated crops among general physical mutagens [7]. Gamma rays is the most energetic form of electromagnetic radiations. Their energy level is from ten to several hundred kilo electron volts and they are considered as the most penetrating than other radiations [8]. Gamma radiation can be very used as the alteration of physiological aspects [9].The radicals produced by the gamma rays can damage and affect changes in plant morphology, anatomy, biochemistry, and physiology depending on the irradiation level. The lower exposure of gamma rays are sometimes stimulatory and several studies reported that the improvements found in agronomic characteristics by using gamma radiation [10].Gas chromatography and Mass Spectrometry, the suitable technique to identify the bioactive constituents of long chain hydrocarbons, alcohols, acids, esters, ethers *etc* [11]. In plant breeding techniques, physical and chemical mutagens are applied successfully for the development of new varieties with enhanced traits [12].

Objective

To evaluate the viable seeds of cultivar Arka anamika with different doses of gamma rays to observe the growth parameters and phytochemical compounds through GC-MS analysis.

MATERIALS AND METHODS

Experimental materials

The important traditional variety of Bhindi (Arka anamika) is obtained from Indian Institute of Horticulture Research, Hessaraghatta lake post, IIHR Main Road, Indian Institute of Horticulture Research, Ivarkandapura, Bengaluru, Karnataka 560089, India.

Gamma irradiation

The seeds were irradiated with six different dose levels such as 100Gy, 200Gy, 300Gy, 400Gy, 500Gy, and 600Gy.These doses were delivered from the dose rate of 12.5Gy per minute low dose irradiation from Caesium-137 source installed at National Research Centre for Banana, Somarasempettai-Thogaimalai Road, Thayanur, Trichy, Tamil Nadu 620102, India. The experiment was laid out in randomized block design, with six treatments along with control and three replications. The 100 seeds of each six treatments were sown in the field immediately after irradiation at the rate of 20 progeny rows/treatment with proper randomization. Data on qualitative and quantitative characters of M_1 generation were gathered from 25 plants/treatment. The following M_1 characteristics like percentage of germination and survival, height of the plant , length of the internode and number of leaves per plants were observed.

Preparation of sample and GC-MS instrumentation

The aqueous methanolic extract was prepared to carried out the various phytochemical compounds. The GC-MS instrument represents a device that separates chemical mixtures (the GC Component and a very sensitive detector the MS component) with a data collector (the computer component). The shimadzu GCMS QP 2020 was used in the

analysis employed a fused silica column, packed with SH-Rxi-%Sil MS (30 m × 0.25 mm ID × 250 µm df) and the components were separated by using Helium as carrier gas at a constant flow of 1 ml/min. The injector temperature was set at 280°C during the chromatographic run. The 1µL of extract sample injected into the instrument and the oven temperature was as follows: 40°C (2 min) followed by 280°C at the rate of 10°C min−1 and 280°C, for 3 min. The mass detector conditions were transfer line temperature 280°C ion source temperature 230°C and ionization mode electron impact at 70 eV, the scan time was 0.2 with interval interval of 0.1 sec. The fragments from 40 to 550 Da. The spectrums of the components were compared with the database of spectrum of known components stored in the GC-MS NIST (2017) library.

RESULTS AND DISCUSSION

The effect of different doses of gamma rays on growth characteristics of Arka anamika cultivar of bhindi was presented in Table 1. The overall M_1 parameters like germination percentage, survival percentage, plant height, internodal length, number of leaves per plant showed a decreasing trend with increasing doses of gamma irradiation. The direct effect of the mutagen is had observed in the first generation of mutagenesis.

Growth parameters

The germination percentage was 97.51 recorded in control seeds of Arka anamika and the exposure to gamma rays showed a reduction in germination such as 91.23, 87.53, 85.66, 79.66, 77.33 and 75.66 per cent respectively in 100, 200, 300, 400, 500 and 600Gy of gamma rays in Arka anamika. In the present part of the research work in Arka anamika indicated that, the increasing doses of gamma irradiation decreased the germination and survival percentage. In respect of gamma ray treatment, similar results were reported in bhindi by [13] and [14]. The same trend was observed in several other plants like blackgram [15] Soybean [16], and rice [17] Soybean [18] and cowpea [19]. On 30th day after showing the survival percentage was calculated in Arka anamika in control and gamma radiation treated populations and there was a gradual reduction in survival of plants with increasing doses gamma irradiation. It was 96.00, 90.66, 83.00, 80.00,78.67, 76.29 and 70.34 per cent respectively in control, 100, 200, 300, 400, 500 and 600Gy of gamma rays in Arka anamika**.** On 40th day after showing the height of the plants was calculated in Arka anamika of the control and gamma irradiation treatments. There was a gradual reduction of plant height with increasing doses of gamma irradiation. It was 34.51, 32.76, 30.63, 28.35, 27.90, 25.94 and 24.39 cm in Arka anamika respectively in control, 100, 200, 300, 400, 500 and 600Gy.The same trend was noticed in soyabean [20] and [21]. Similar results were reported that increased dose of gamma rays decreased the percentage of germination and survival of seedlings in okra. [22] and [23].

GC-MS analysis

In the process of Gas chromatography and mass spectrometry, the cultivar of Arka anamika revealed various phytochemical compounds according to their doses of gamma radiation treatment. The identified chemical compounds composition of cultivars Arka anamika is shown in Table 2.The phytochemical compounds identification was established on the basis of peak area (value), total number of compounds, total number of new compounds and total number of common compounds. There were totally eighteen phytochemical compounds was observed in control. In 100Gy, 200Gy there are thirteen and eighteen phytochemical compounds had noticed respectively. In the physical mutagenic treatment of 300Gy only seventeen compounds were noticed. Like 200Gy and eighteen compounds was observed in 400Gy. The total number of phytochemical compounds in 500Gy had expressed only eleven, but there were thirteen phytochemical compounds observed in 600Gy. Among the treatment of 100Gy, 200Gy, 300Gy, 400Gy, 500Gy, and 600Gy five common phytochemical compounds such as Neophytadine, Phytol, n-Hexa decanoic phytochemical compounds , 9,12,15 Octade-catrienoic acid(Z-Z-Z) and Octade canoic acid. In the present study, the GC – MS was carried out in okra leaves obtained from different concentrations of physical mutagenic treatment. There are several highest and lowest peaks of phytochemical compounds were calculated in the various physical mutagenic treatments. In the control, the highest peak value Octade catrienoic acid (Z-Z-Z) was 12.18% and lowest peak value of Neophytodine was 0.81%. In 100Gy, has highest peak value about 21.81% of n-

hexadecanoic acid and Neo phytodine has lowest peak value of (1.24%). The highest peak value of (15.88%) 9,12,15 Octa decatrienoic acid (Z-Z-Z) was observed in the mutagenic treatment of 200Gy. In the same, it has lowest peak value of 14-Beta-H-Pregna was 0.83%.In 300Gy, the highest peak value of n-Hexa decanoic acid was 18.64% at the same treatment the lowest phytochemical compounds of tetrapenta contane contain 0.77% of lowest peak value. Both highest and lowest peak value of phytochemical compounds at the 400Gy (18.28%) n-Hexa decanoic acid and (0.62%) Tetra cosamethyl-cyclodode casiloxane respectively.

The lowest peak are of (1.17%) phytochemical compounds Isophathlic acid ad highest peak area of (23.39%) Hexa decanoic acid, 2hydroxy-1-(hydroxymtheyl) were observed in 500Gy.The maximum level of physical mutagenic treatment of 600Gy were expressed both highest peak value of phytochemical compounds namely 24.75% of Hexa decanoica acid, 2 hydroxy, 1-(hydroxmethyl) and 1.33% of Hexoanoic acid. The physical mutagenic treatment of 400Gy, 500Gy, and 600Gy was containing different new phytochemical compounds. The common phytochemical compounds such as Neophytadiene, Phytol, n-Hexadecanoic acid, 9, 12,15 Octadecatrienoic acid (Z-Z-Z) and Octadecanoic acid were expressed in treatment of 100Gy, 200Gy, 300Gy, 400Gy, 400Gy, 500Gy and 600Gy (Table 3 and Figure 1-7). Similar results were reported by several author in okra the various phytochemical compounds in leaves of okra [24]. and the comparative analysis of phytochemical compounds in normal and root gall of okra plant carried out GC-MS analysis in *Typhonium flagelliforme* Lodd. Mutants obtained from gamma irradiation. [25] and [26].

CONCLUSION

The present study is really very useful to understand the effect of gamma rays on the growth and phytochemical compounds of the plant bhindi cv - *Arka anamika*.

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Table 01: Effects of gamma rays on bhindi (Arka anamika) growth parameters.

Dose of gamma irradiation	Germination percentage	Survival percentage	Plant height (cm)	Internodal length	Number of leaves per pant
Control	97.51	96.00	34.51±6.04	10.73±0.82	23.31±1.02
100Gy	91.23	90.66	32.76±3.26	9.81±0.81	21.62±0.97
200Gy	87.53	83.00	30.63±5.34	9.01±0.74	19.16±1.12
300Gy	85.66	80.00	28.35±5.03	8.87±1.63	16.13±1.02
400Gy	79.66	78.67	27.90±3.16	7.73±0.70	14.54±1.23
500Gy	77.33	76.29	25.94±3.20	6.28±1.17	12.87±1.17
600Gy	75.66	70.34	24.39±1.70	5.94±0.78	10.96±0.64

Table 02: Compounds isolated from GC-MS analysis from leaf sample of Arka anamika.

S. No	Treatment	Total No. of Components	Total No. of New Components	Common compounds
1.	Control	18	-	1
2.	100Gy	13	5	2
3.	200Gy	18	9	3
4.	300Gy	17	10	4
5.	400Gy	18	9	5
6.	500Gy	11	4	3
7.	600Gy	13	5	2

Table 03: Effect of gamma rays on highest and lowest peak area of phytochemical compounds of Arka Anamika.

Treatment	Phytochemical compounds	Percentage of peak area (highest) (%)	Phytochemical compounds	Percentage of peak area (lowest) (%)
Control	9,12,15 octadecartri enoic acid (Z,Z,Z)	12.18	Neophytodine	0.81
100Gy	n-Hexadecanoic acid	21.81	Neophytodine	1.24
200 Gy	9,12,15 octadecartri enoic acid (Z,Z,Z)	15.88	14 Beta-H- Pregna	0.83
300 Gy	n-Hexadecanoic acid	18.64	Tetrapentacontane	0.77
400 Gy	n-Hexadecanoic acid	18.64	Tetracosamethyl	0.62
500 Gy	Hexa decanoic acid 2 hydroxy-1- (hydroxymethyl)	23.39	Isopathalic acid	1.17
600 Gy	Hexa decanoic acid 2 hydroxy-1- (hydroxymethyl)	24.75	Hexanoic acid	1.33

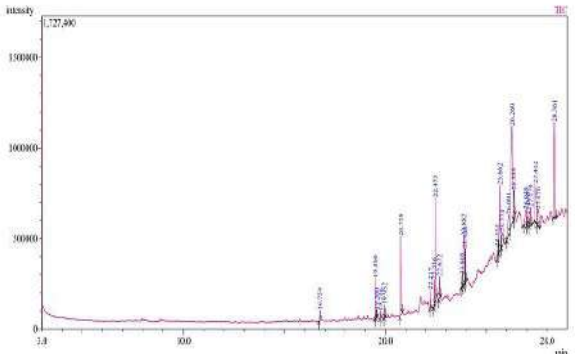

Figure 1. control.

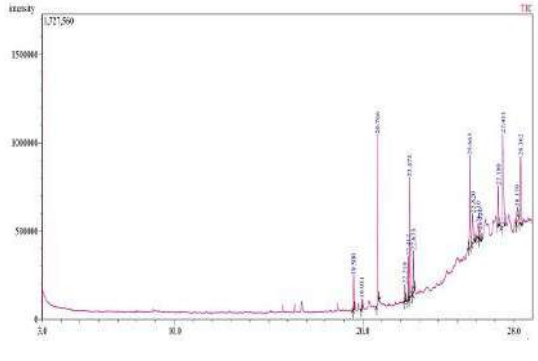

Figure 2. 100Gy

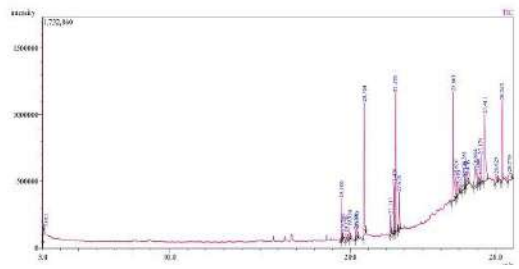

Figure 3. 200 Gy

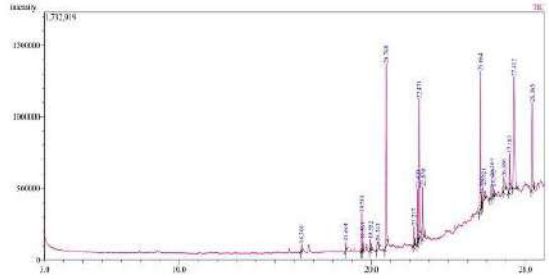

Figure 4 . 300 Gy

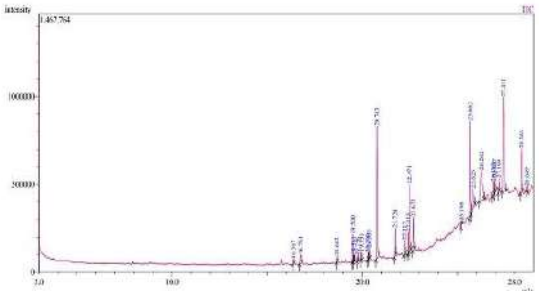

Figure 5. 400 Gy

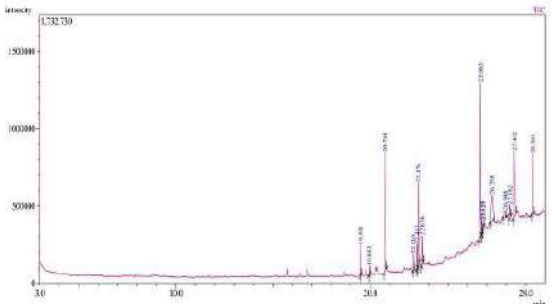

Figure 6 . 500 Gy

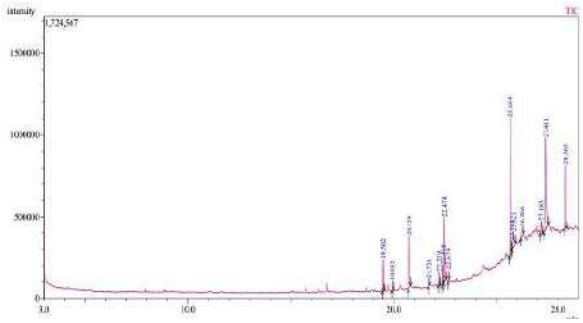

Figure 7. 600 Gy [Figure 1-7 . Effect of gamma rays on GC-MS analysis in M_1 generation.]

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RESEARCH ARTICLE

Response of Zinc and Manganese with Fortified Organics for Increasing Yield, Quality and Economics of Sesame under Coastal Saline Sandy Soil

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ABSTRACT

A field experiment was conducted in the farmer's field at Perampattu coastal village, near Chidambaram in Cuddalore district of Tamil Nadu, during March–June, 2021. The experimental soil was sandy loam in texture and taxonomically classified as *Typic ustifluvent* with pH-8.41, EC-4.11 dSm^{-1} and analysed low status of soil organic carbon (2.27 g kg^{-1}). The soil analysed low in alkaline $KMnO_4$–N (139.50 kg ha^{-1}), Olsen-P (9.30 kg ha^{-1}) and medium in NH_4OAc-K (162.31 kg ha^{-1}). The available Zn (DTPA extractable Zn) content (0.71 mg kg^{-1}) was also low in soil. The results of the field experiment clearly indicated that application of micronutrients (Zn + Mn) fortified organics + micronutrients either through soil or foliage along with recommended dose of fertilizers (RDF) and PPFM through foliage significantly and positively increased the seed yield (953 kg ha^{-1}), protein and oil yield (259.59 and 457.43 kg ha^{-1}), BCR (2.54) and net return (26291 ha^{-1}) of sesame.

Keywords: Zinc, Manganese, Fortified organics, Yield, Quality, Economics, Sesame, Coastal saline sandy soil

INTRODUCTION

The Indian peninsular region has 8,129 km long coastline. The total geographical coastal area of the country is as high as 10.78 M ha. Tamil Nadu alone occupies 6,80,622 ha of coastal area constituting 26.8 per cent of the total area of the

coastal districts. In India, coastal region covers a long strip, over the eastern and western border are severely degraded and, pose serious problems for agricultural production (Ray *et al*., 2014). Coastal saline soils cover an area of about 932.2 M ha in the world, of which 56 M ha comprises secondary salinized irrigated lands (Quadir *et al*., 2014). In the world about 833 M ha are salt affected soils. In India, around 6.72 M ha 2.95 M ha in saline and 3.77 M ha in sodic, in Tamil Nadu. Nearly 2.04 L ha are coastal saline soil (Mandal *et al*., 2018). In coastal areas agriculture sector meets a lot of problems such as seawater intrusion, poor quality water, cyclones and flood which leads to low production. Severe drainage and soil salinity issues typically affect low-lying agricultural fields. Crop productivity is more seriously affected by soil and water salinity in the coastal ecosystem. During the era of green revolution, introduction of high-yielding varieties, extension of irrigated areas, use of high analytical value of NPK fertilizers and increase in cropping intensity, boosted the production in most of cases, propelled India towards self-sufficiency in food production. In the process, relative contribution of organic manures as a source of plant nutrients *vis-a-vis* chemical fertilizers declined substantially (Bhadu *et al*. 2017). One way of replenishing nutrients in the arable lands is to recycle nutrients through application of organic material such as litter, crop residues, and manures. Organic manures, especially farmyard manure, have a significant role for maintaining and improving the physical, chemical and biological properties of soils.

Organic materials play a critical role in sustainability in the coastal regions. Despite this importance, there is little predictive understanding for the management of organic inputs in coastal agro ecosystems. It is now widely recognized that soil organic matter plays an important role in soil physical, chemical (pH, base saturation, salinity and CEC changes) and biological properties. Organic amendments, such as FYM and composted agro industrial bi-products are known to improve soil physical properties. Organic matter is an important soil constituent influencing a number of constraints linked with crop productivity. The loss of soil fertility, in many developing countries, due to continuous nutrient depletion by crops without adequate replenishment poses an immediate threat to food and environmental security. Intensive cropping and tillage system have led to substantial decreases in soil organic matter levels of much prime land in the world. This decrease in soil organic matter levels seems to be associated with the decline in soil productivity. Hence, the application of organics is essential for maintaining soil fertility. Use of fortified organic manures is one of the technologies to enhance the nutrient use efficiency as well as decrease the nutrient losses (Aswini *et al.* 2015). The aim of enrichment of organic manures is to minimize excess use of fertilizers for optimum yield and quality of sesame crops without harming soil and environment health by the application of micronutrients fortified organic manures like plant nutrient enriched FYM.

Among the oilseeds, sesame (*Sesamum indicum* L.) is one of the most important oilseed crop grown in coastal soils. India is the highest producer of sesame in the world which occupies an area of 17.6 lakh ha with a production of 7.85 lakh tones, however the average yield is very low (446 kg ha^{-1}) as compared to national average yield of around 700-800 kg ha^{-1} (Elayaraja *et al*., 2019). In Tamil Nadu, the area under cultivation of sesame is 1.12 lakh hectares with a production of about 16,000 tonnes and average productivity is 589 kg ha^{-1} (Kaul *et al.,* 2020). The short duration, drought tolerant, low water and nutrient requirement of sesame attracts many farmers in these regions to cultivate this crop. However, the yield obtained on the coastal regions are very low and far below the national average yield. Nutritional imbalance in plants due to inadequate availability of both macro and micronutrients in coastal saline soil was established as the prime reason for low yield potential of oilseed crops. A significant portion of the aerobic, heterotrophic microflora on the surfaces of young leaves is composed of pink-pigmented facultative methylotrophic bacteria (PPFM), which are common in nature and frequently documented on different plant species (Meena *et al.,* 2012). They can also thrive on C_1 substances including formate, formaldehyde, and methanol in addition to C_2-C_4 substances. Auxins and cytokinins, which influence plant development and other physiological processes, are examples of plant growth regulators that they can create. The PPFM can also induce systemic resistance against diseases and degrade a widely range of highly toxic compounds and tolerate heavy metals (Iguchi *et al*, 2015 and Gawad *et al*., 2015). Because of their high Zn content (20–25%) and simple water solubility, $ZnSO_4$ and $MnSO_4$ are the most popular and commonly utilised micronutrient fertilisers among farmers. Additionally, coastal sandy/sandy loam soils are easily leachable due to low organic matter and significant leaching losses, which led to low Zn availability or usage efficiency in crop plants. In this regard, enriched

organic manures with micronutrients are increasingly being used as a well-recognized method of nutrient supplementation in crop cultivation to boost sesame output and quality. In addition to that some part of water soluble Zn may be converted to insoluble $ZnCO_3$ and $Zn(OH)_2$. However, other than zinc sources like ZnEDTA is costlier than zinc and manganese fortified composted coirpith and FYM (ZnECCP/ZnEFYM) therefore it is not affordable to farmers and increase the cost of production. Hence, inclusion of recommended dose of NPK fertilizer, micronutrient fertilizer like zinc along with Zn or Mn fortified manures techniques becomes an imperative need to improve the yield of oil seed production.

MATERIALS AND METHODS

The field experiment was conducted in the farmer's field at Perampattu coastal village, near Chidambaram, Cuddalore District, Tamil Nadu, India. The experimental site is geographically located at 11°24′ N latitude, 79°44′ E longitudes and altitude of ± 5.79 M above mean sea level (MSL) in the southern part of India and 15 km away from the Bay of Bengal coast. The experimental soil was sandy loam texture and taxonomically classified as *Typic Ustifluvent* with pH-8.41, EC-4.11 dSm^{-1} and analysed low status of soil organic carbon (2.27 g kg^{-1}). The soil analysed low in alkaline $KMnO_4$–N (139.50 kg ha^{-1}), Olsen-P (9.30 kg ha^{-1}) and medium in NH_4OAc-K (162.31 kg ha^{-1}). The available Zn (DTPA extractable Zn) content (0.71 mg kg^{-1}) was also low in soil. The various treatments imposed in the study were T_1–Control (RDF/100% NPK alone), T_2 – RDF + FYM @ 12.5 t ha^{-1}, T_3 – RDF + Composted coirpith (CCP) @ 12.5 t ha^{-1}, T_4 – RDF + FYM + $ZnSO_4$ @ 25 kg ha^{-1} + $MnSO_4$ @ 5 kg ha^{-1}, T_5 – RDF + CCP + $ZnSO_4$ @ 25 kg ha^{-1} + $MnSO_4$ @ 5 kg ha^{-1}, T_6 –RDF + Micronutrients (Zn + Mn) Fortified FYM (MnFFYM) @ 6.25 t ha^{-1}, T_7 – RDF + Micronutrients (Zn + Mn) Fortified CCP (MnFCCP) @ 6.25 t ha^{-1}, T_8 – RDF + MnFFYM @ 6. 25 t ha^{-1} + $ZnSO_4$ @ 0.5% + $MnSO_4$ @ 0.5% Foliar application (FA), T_9 – RDF + MnFCCP @ 6.25 t ha^{-1} + ($ZnSO_4$ + $MnSO_4$) FA, T_{10} – RDF + MnFFYM @ 6.25 t ha^{-1} + ($ZnSO_4$ + $MnSO_4$) FA + Pink Pigmented Facultative Methylotrophic bacteria (PPFM) @ 1.0% FA and T_{11} –RDF + MnFCCP @ 6.25 t ha^{-1} + ($ZnSO_4$ + $MnSO_4$) FA + PPFM @ 1.0% foliar spray twice at pre flowering stage and flowering stage. The experiment was arranged in a Randomized Block Design (RBD) with three replications. The seed yield from each plot was recorded at 14 per cent moisture content and expressed in kg ha^{-1}. The dry weight of stalk yield from each plot was recorded and expressed in kg ha^{-1}. The oil content of the sesame seed was estimated using diethyl ether as extractant by Soxhlet's apparatus and expressed in per cent (Gupta and Varshaney, 1989). Nitrogen content of sesame seed was estimated as per the procedure outlined in micro Kjeldahl method and, the crude protein content of seed was calculated by multiplying the per cent nitrogen content of seed with 6.25 (Piper, 1966). The protein and oil yield of individual treatments was computed by multiplying the respective oil and protein content with seed yield. The economic parameters such as gross return and benefit- cost ratio for all the treatments were worked out based on the prevailing market price. The net return was worked out for different treatments by subtracting the cost of cultivation from gross return. The return per rupee invested was calculated by dividing gross return and cost of cultivation.

RESULTS AND DISCUSSION

Yield of sesame (Table 1)

The sesame responded well for the micronutrients application. The significant influence of micronutrient fertilization (zinc + manganese) along with 100% recommended NPK and Zn + Mn fortified organics in increasing the seed and stalk yield of sesame was well documented in the present study. The yield realized under the nutrient poverished coastal sandy loam soil, the highest seed yield (953 kg ha^{-1}) and stalk yield (1788 kg ha^{-1}) was recorded with combined application of 100 per cent recommended dose of NPK fertilizer + micronutrients fortified composted coirpith (MNFCCP) @ 6.25 t ha^{-1} through soil as well as foliar spray of $ZnSO_4$ @ 0.5% + $MnSO_4$ @ 0.5 per cent + PPFM @ 1.0 % twice at pre flowering and flowering stage (T_{11}). This was followed by the treatments T_9, (RDF + MNFCCP @ 6.25 t ha^{-1} + $ZnSO_4$ @ 0.5% + $MnSO_4$ @ 0.5% FA) and T_{10} (RDF + MNFFYM @ 6.25 t ha^{-1} + $ZnSO_4$ @ 0.5% + $MnSO_4$ @ 0.5% + PPFM @ 1.0 % FA) which recorded the seed (920 and 911 kg ha^{-1}) and stalk (1696 and 1683 kg ha^{-1}) yield of sesame, respectively. The treatments T_9 and T_{10} were found to be on par with each other. This was followed by the treatment T_8, (RDF + MNFFYM @ 6. 25 t

ha^{-1} through soil application along with $ZnSO_4$ + $MnSO_4$ @ 0.5 per cent through foliar application). Individual or sole application of micronutrients (Zn or Mn) fortified organics alone or micronutrients + organics alone (without fortified) along with NPK and organics applied treatments recorded the lowest yield of sesame as compared to above said treatments (RDF+ fortified organics + micronutrients and PPFM). This was followed by the treatments arranged in the descending order like T_7, (RDF + MNFCCP @ 6.25 t ha^{-1}), T_6 (RDF + MNFFYM @ 6.25 t ha^{-1}), T_5 (RDF + CCP +$ZnSO_4$ @ 25 kg ha^{-1} + $MnSO_4$ @ 5 kg ha^{-1}), T_4 (RDF + FYM + $ZnSO_4$ @ 25 kg ha^{-1} + $MnSO_4$ @ 5 kg ha^{-1}), T_3 (RDF + Composted coirpith (CCP) @12.5 t ha^{-1}) and T_2 (RDF + FYM @ 12.5 t ha^{-1}) which recorded the seed (838, 802, 761, 726, 688 and 656 kg ha^{-1}) and stalk (1485, 1392, 1296, 1186, 1081 and 977 kg ha^{-1}) yield of sesame, respectively. Among the various micronutrients fortified organics applied treatments, the treatment (T_{11}), 100% recommended dose of NPK + micronutrients (Zn + Mn) fortified composted coirpith @ 6.25 t ha^{-1} through soil application along with foliar spray of $ZnSO_4$ @ 0.5% + $MnSO_4$ @ 0.5% and PPFM @ 1.0% twice recorded a seed and stalk yield of 953 and 1788 kg ha^{-1} which was 34.73 and 51.67 per cent increase over control or 100 per cent NPK alone (without micronutrients and fortified organics). The control treatment T_1, 100 per cent NPK alone recorded a lower seed (622 kg ha^{-1}) and stalk (864 kg ha^{-1}) yield of sesame, respectively.

Higher yield in the enriched organic manures applied treatment might also be due to the contribution of micronutrients released from enriched organic manures attributed to involvement in many enzyme system, recycling functions and auxin production (Veeranagappa *et al*., 2010a) and enhanced synthesis of carbohydrates and their transport to the site of seeds formation (Ahmad *et al*., 2012). Further, increased in photosynthesis during growth stages might be contributed for greater assimilates supply to the capsules which resulting in better seed setting and also betterment of higher seed yield of sesame. PPFMs excrete auxins and cytokinins, plant growth hormones that influence more number of flowering, capsule filling and play critical roles in a plant's response to water/drought/saline stress condition. The results are in conformity with Irvine *et al*. (2012); Meena *et al*. (2012) and Jeyajothi *et al*. (2014).

QUALITY PARAMETERS OF SESAME (Table 2)

Oil and protein content

The influence of different methods of micronutrients (zinc and manganese) fertilization along with micronutrients fortified organics (MNFCCP, MNFFYM) and NPK treatments in altering the quality parameters *viz*., oil and protein content of sesame seeds was not statistically significant.

Oil and protein yield

The micronutrient fertilization through soil or foliar application of zinc + manganese and PPFM along with micronutrients fortified organics and recommended dose of NPK exerted a significant influence on protein and oil yield of sesame. Among the treatments, the application of micronutrients fortified composted coirpith (MNFCCP) @ 6.25 t ha^{-1} + recommended dose of NPK fertilizer through soil application and foliar application of $ZnSO_4$ @ 0.5% + $MnSO_4$ @ 0.5% along with PPFM @ 1.0 per cent twice (T_{11}) registered a significantly higher oil (457.43 kg ha^{-1}) and protein yield (259.59 kg ha^{-1}) of sesame seed. This was followed by the application of RDF + MNFCCP @ 6.25 t ha^{-1} through soil application along with and foliar application of $ZnSO_4$ @ 0.5% + $MnSO_4$ @ 0.5 per cent twice (T_9) recorded the highest oil and protein yield of sesame seed. However, it was found to be comparable with the treatment T_{10}, (RDF + RDF + MNFFYM @ 6.25 t ha^{-1} through soil + $ZnSO_4$ @ 0.5% + $MnSO_4$ @ 0.5% + PPFM @ 1.0% through foliar application). These two treatments registered a comparable oil (432.44 and 438.71 kg ha^{-1}) and protein (246.96 and 248.02 kg ha^{-1}) yield of sesame seed. This was followed by the application of RDF + RDF + MNFFYM @ 6.25 t ha^{-1} through soil and $ZnSO_4$ @ 0.5% + $MnSO_4$ @ 0.5 per cent foliar spray (T_8), application of RDF + MNFCCP @ 6.25 t ha^{-1} (T_7), application of RDF + MNFFYM @ 6.25 t ha^{-1} (T_6) and application of RDF + CCP + $ZnSO_4$ @ 25 kg ha^{-1} + $MnSO_4$ @ 5 kg ha^{-1} (T_5), application of RDF + FYM + $ZnSO_4$ @ 25 kg ha^{-1} + $MnSO_4$ @ 5 kg ha^{-1} (T_4), application of RDF + CCP @ 12.5 t ha^{-1} (T_3) and application of RDF + FYM @ 12.5 t ha^{-1} (T_2) recorded the significantly decreased the oil (415.43, 389.68, 371.12, 352.40, 338.61, 311.90 and 299.96 kg ha^{-1}) yield and protein (334.08, 221.18, 216.18, 200.59, 190.70, 176.92 and 168.41 kg ha^{-1}) yield of sesame seeds, respectively. The lowest quality parameters *viz*., oil (279.27 kg ha^{-1}) and protein yield (155.93 kg ha^{-1}) was recorded in the control or RDF alone (without micronutrients fortified organics and PPFM) as compared to all other treatments. Application of inorganic nutrients both macro and

micronutrients along with fortified organics increased the seed yield and nutrient availability which resulted in better accumulation of N and hence the protein content in sesame seeds (Arulrajasekaran, 2019). Besides the addition of zinc as $ZnSO_4$, manganese as $MnSO_4$ promoted better quality through synthesis of oil, protein and amino acids through its effect on protein and lipid metabolism in plants. Similar results were earlier made by Salwa *et al.* (2010); Tripathy and Bastia (2012) and Sidhu *et al*. (2015). Further, higher protein yield might be due to the increased nitrogen content in seed which intern helped to increase the protein yield of sesame seeds. These results confirm the findings of Marko *et al.* (2013). The impact of NPK along with micronutrients enriched organics addition plays a vital role in enhancing the glycoside content in seed, which upon hydrolysis and estrifications resulted in higher oil yield of sesame seeds. In line with the present study, Sidhu *et al.* (2015) and Mahajan *et al.* (2016) also reported similar finding.

Economics of the sesame production (Table 3)

The benefit cost ratio was worked out to realize beneficial influence of different methods of micronutrients (Zn and Mn) fertilization along with recommended dose of NPK and micronutrients fortified organic manures application in increasing the net profit over the conventional methods of sesame production and/or farmers practice. The net income per ha (gross income-cost of cultivation) and the benefit cost ratio (return per rupee invested) was greatly increased with increased with the micronutrients (Zn+Mn) fortified/ enriched organics (MNFCCP/MNFFFYM) application through soil + foliar spray of $ZnSO_4$ + $MnSO_4$ and PPFM along with recommended dose of NPK fertilizers.Among the various treatments, the highest net income (Rs. 26291 ha^{-1}) and benefit cost ratio (Rs. 2.54) were obtained with the soil application of micronutrients (Zn+Mn) fortified composted coirpith (MNFCCP) @ 6.25 t ha^{-1} and foliar application of $ZnSO_4$ and MnSO4 @ 0.5% + pink pigmented facultative methylotrophic bacterium (PPFM) @ 1.0 per cent twice at pre flowering stage (PFS) and flowering stage (FS) along with recommended dose of NPK (T_{11}). This was followed by application of RDF + MNFCCP @ 6.25 t ha^{-1} through soil along with 0.5% foliar spray of $ZnSO_4$ and $MnSO_4$ (T_9). However, it was found to be comparable with the treatment T_{10} (the application of RDF (100% NPK) + MNFFYM @ 6. 25 t ha^{-1} through soil along with 0.5% foliar application of $ZnSO_4$ + $MnSO_4$ and PPFM @ 1.0%). The lowest net income (Rs. 21636 ha^{-1}) and benefit cost ratio (Rs. 2.01) was observed in the control treatment (without micronutrients and fortified organics). The economics worked out in the field experiment revealed that the beneficial role of micronutrients fortified organic manure treatments, application of fortified organics, inorganic fertilizer along with PPFM increasing the net returns and benefit: cost ratio (B:C ratio, returns per rupee invested). The highest net income (Rs. 26291) and B:C ratio (2.54) was recorded with the integrated application of 100 per cent recommended dose of NPK + micronutrients (Zn + Mn) fortified composted coirpith (MNFCCP) @ 6.25 t ha^{-1} through soil along with foliar spray of $ZnSO_4$ + $MnSO_4$ @ 0.5% and PPFM @ 1.0% as compared to all other treatments. The increase in the economic yields of sesame and hence the economic values of the yield support the cost of cultivation and ultimately resulted in higher net return and also the benefit: cost ratio. The earlier reports of Chaurasia *et al*. (2009); Yadav *et al*. (2009); Kumawat *et al*. (2012) and Mahajan *et al.* (2016) also support the present results.

CONCLUSION

Among the various fortified organics treatments, combined application of recommended dose of fertilizer (RDF) along with micronutrients (Zn and Mn) fortified composted coirpith (ZnECCP) @ 6.25 t ha^{-1} through soil + foliar application of $ZnSO_4$ @ 0.5% + $MnSO_4$ @ 0.5% and pink pigmented facultative methylotrophs (PPFM) @ 1.0 per cent twice at pre flowering and flowering stage excelled all other treatments by recording the highest seed Yield (953 kg ha^{-1}), protein and oil yield (259.59 and 457.43 kg ha^{-1}), net return of Rs. 40,419 ha^{-1} and benefit cost ratio of 2.54.

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Table 1. Effect of fortified organic manures and micronutrient fertilization on the yield of sesame

Treatments	Yield (kg ha^{-1})	
	Seed	Stalk
T_1– Control (RDF/100% NPK alone)	622	864
T_2 –RDF + FYM @ 12.5 t ha^{-1}	656	977
T_3 –RDF + Composted coirpith (CCP) @ 12.5 t ha^{-1}	688	1081
T_4 –RDF + FYM + $ZnSO_4$ @ 25 kg ha^{-1} + $MnSO_4$ @ 5 kg ha^{-1}	726	1186
T_5 –RDF + CCP + $ZnSO_4$ @ 25 kg ha^{-1} + $MnSO_4$ @ 5 kg ha^{-1}	761	1296
T_6 –RDF + MNFFYM @ 6.25 t ha^{-1}	802	1392
T_7 –RDF + MNFCCP @ 6.25 t ha^{-1}	838	1485
T_8 –RDF + MNFFYM @ 6.25 t ha^{-1} + $ZnSO_4$ + $MnSO_4$ @ 0.5% (FA)	877	1589
T_9 –RDF + MNFCCP @ 6.25 t ha^{-1} + $ZnSO_4$ + $MnSO_4$ @ 0.5% (FA)	920	1696
T_{10} – RDF + MNFFYM @ 6.25 t ha^{-1} + ($ZnSO_4$ + $MnSO_4$) FA + PPFM @ 1.0% FA	911	1683
T_{11} –RDF + MNFCCP @ 6.25 t ha^{-1} + ($ZnSO_4$ + $MnSO_4$) FA + PPFM @ 1.0% FA	953	1788
SE_D	14.78	34.02
CD (p=0.05)	31.04	71.46

Table 2. Effect of fortified organic manures and micronutrient fertilization on the quality parameters of sesame

Treatments	Oil content (%)	Protein content (%)	Oil yield (kg ha^{-1})	Protein yield (kg ha^{-1})
T_1– Control (RDF/100% NPK alone)	45.06	25.23	277.32	155.93
T_2 –RDF + FYM @ 12.5 t ha^{-1}	45.42	25.52	299.96	168.41
T_3 –RDF + Composted coirpith (CCP) @ 12.5 t ha^{-1}	45.77	25.86	311.90	176.92
T_4 –RDF + FYM + $ZnSO_4$ @ 25 kg ha^{-1} + $MnSO_4$ @ 5 kg ha^{-1}	46.09	26.13	338.61	190.70
T_5 –RDF + CCP + $ZnSO_4$ @ 25 kg ha^{-1} + $MnSO_4$ @ 5 kg ha^{-1}	46.57	26.49	352.40	200.59
T_6 –RDF + MNFFYM @ 6.25 t ha^{-1}	46.01	26.83	371.12	216.18
T_7 –RDF + MNFCCP @ 6.25 t ha^{-1}	46.31	26.11	389.68	221.80
T_8 –RDF + MNFFYM @ 6.25 t ha^{-1} + $ZnSO_4$ + $MnSO_4$ @ 0.5% (FA)	46.80	26.35	415.43	234.08
T_9 –RDF + MNFCCP @ 6.25 t ha^{-1} + $ZnSO_4$ + $MnSO_4$ @ 0.5% (FA)	47.36	26.74	438.71	248.02
T_{10} – RDF + MNFFYM @ 6.25 t ha^{-1} + ($ZnSO_4$ + $MnSO_4$) FA + PPFM @ 1.0% FA	47.25	26.67	432.44	246.96
T_{11} –RDF + MNFCCP @ 6.25 t ha^{-1} + ($ZnSO_4$ + $MnSO_4$) FA + PPFM @ 1.0% FA	47.79	27.03	457.43	259.59
SE_D	0.16	0.11	5.26	2.48
CD (p=0.05)	NS	NS	11.05	5.22

Table 3. Effect of fortified organic manures and micronutrient fertilization on the Economics of sesame

Treatments	Cost of cultivation (Rs.)	Gross income (Rs.)	Net return (Rs.)	Benefit cost ratio (Rs.)
T_1– Control (RDF/100% NPK alone)	21636	43540	21904	2.01
T_2 –RDF + FYM @ 12.5 t ha^{-1}	31109	45920	14811	1.48
T_3 –RDF + Composted coirpith (CCP) @ 12.5 t ha^{-1}	26686	48160	21474	1.80
T_4 –RDF + FYM + $ZnSO_4$ @ 25 kg ha^{-1} + $MnSO_4$ @ 5 kg ha^{-1}	32863	50820	17957	1.55
T_5 –RDF + CCP + $ZnSO_4$ @ 25 kg ha^{-1} + $MnSO_4$ @ 5 kg ha^{-1}	28443	53270	24827	1.87
T_6 –RDF + MNFFYM @ 6.25 t ha^{-1}	28129	56140	28011	2.00
T_7 –RDF + MNFCCP @ 6.25 t ha^{-1}	25919	58660	32741	2.26
T_8 –RDF + MNFFYM @ 6.25 t ha^{-1} + $ZnSO_4$ + $MnSO_4$ @ 0.5% (FA)	28349	61390	33041	2.17
T_9 –RDF + MNFCCP @ 6.25 t ha^{-1} + $ZnSO_4$ + $MnSO_4$ @ 0.5% (FA)	26139	64400	38261	2.46
T_{10} – RDF + MNFFYM @ 6.25 t ha^{-1} + ($ZnSO_4$ + $MnSO_4$) FA + PPFM @ 1.0% FA	28500	63770	35270	2.24
T_{11} –RDF + MNFCCP @ 6.25 t ha^{-1} + ($ZnSO_4$ + $MnSO_4$) FA + PPFM @ 1.0% FA	26291	66710	40419	2.54

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RESEARCH ARTICLE

Diversity of Spiders Associated with Chickpea and Wheat Crops at Badodar, Junagadh, Gujarat, India

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ABSTRACT

This research was carried out in wheat and chickpea agro-ecosystem at Badodar, Gujarat from time period of October 2020 to March 2021 in order to determine the spider fauna. Among the 147 specimens collected, 20 species belonging to 10 genera and 9 families were recorded from these regions in which, 11 species from wheat and 15 species from chickpea crops were recorded. Among all observed species, Araneidae (27%) and Salticidae (21%) family were dominant in both crops. Maximum diversity was observed in the month of November and December in wheat and chickpea crops respectively.

Keywords: Spiders, Wheat, Chickpea, Badodar, Gujarat

INTRODUCTION

Spiders belong to most diverse group of organisms which ranks seventh in the global diversity (Plantnick and Raven, 2013). The current world list of spider includes 50,069 species under 4,249 genera and 131 families (WSC 2022). India has over 1,686 species belonging to 438 genera under 60 families (Keswani *et. al*, 2012). All Spiders are predacious, they primarily feeds on insects. But they have been neglected as potential biological control agents in agro ecosystem. Since then a number of studies have investigated the role of spiders in cultivated crops. The population of spiders increases with the increase in population of hoppers and decreases with increase in temperature, wind, velocity, sunshine hour and rainfall (Chandra, 2007). Because of their high abundance and predominantly insectivorous feeding habits, spiders are suspected to play an important predatory role in agro ecosystems by lowering the insect densities, as well as stabilizing pest populations (Saranya *et. al*, 2019). India is the

largest chickpea producer on 8.2 m/ha, with a production of 7.5 m tons (Ranga Rao and Shanower, 1999). The pod borer (*H. armigera*) and the aphid (*A. craccivora*) are the major pests of chickpea in the Indian subcontinent. Wheat is one of the oldest and most important cereal crop. Many insects feed on wheat which can cause serious yield losses. Pink borer (*Sesamia inferens*), Wireworm (*Argiotes* sp.), Aphids (*Mythimna* sp.), Grasshopper (*Atractomorpha* sp.) and Termites are the dominant pests of wheat. Spiders are most abundant and diversified natural enemies, which contribute to the reduction of several pests. In addition to kill the pest directly, the spiders cause pest's mortality indirectly by dislodging them from the crops or trapping the insects in their webs (Soomro, 2018). However, certain pest management practices, such as the application of pesticides, can disrupt their role as pest control (Pekar, 2013). Absolutely no work has been carried out on the spider diversity in agro ecosystem from this area. Hence, the present study was undertaken to record the spider fauna of selected site.

MATERIALS AND METHODS

Study was carried out during October 2020 to March 2021 from two different crops: Chickpeas and Wheat. Study site is spread over 363,517 m^2 (36.4 ha) and situated at 21°19'52.51"N and 70°15'59.84"E (Fig. 1). Collection was performed by random sampling techniques using active search, hand picking, pitfall trap, inverted umbrella and beating sheet. After collection, samples were transferred into plastic vials and preserved into 70% alcohol for further identification. All adult specimens were identified up to family, genus and species level under binocular stereomicroscope using available literature (Pocock 1900, Tikader 1987, Sebastian and Peter 2009).

RESULT AND DISCUSSION

A total of 147 individuals were collected from the both selected crops from which 20 species from 20 genera belonging 12 families of spiders were recorded including 51 females, 24 males and 72 juveniles (Table 1). In wheat crops, 11 species from 11 genera and 8 families while in Chickpea crops, 15 species from 15 genera and 10 families of spiders were observed. Maximum number of spiders was observed in November and December when crop were in vegetative and reproductive stage. Among the 20 species of spiders, 25% species belonged to family Araneidae, 20% species belonged to family Salticidae, 10% species belonged to family Lycosidae, 5 % species belonged from Oxyopidae, 5% from Cheiracanthidae family, 5% species from Thomisidae family, 5% species from Eresidae family, 5% species from Clubionidae family, 5% species belonged to family Pholcidae family, 5% species from Hersilidae family, 5% species from Sparassidae family and 5% species from family Philodromidae were recorded (Fig. 2). Among the samples collected, the proportion of orb weavers, foliage runners, ground runners, ambusher and stalkers was recorded as 35%, 20%, 15%, 10% and 20% respectively (Fig. 3). According to Srilaxmi and Paul (2010) major species of pests were observed during vegetative stage and maximum spiders were observed during flowering stage. Raval and Ram (2021) reported 63 species of spiders belonging to 44 genera and 15 families from two agro-lands of Junagadh. Lal (1996) stated in his study that *H. armigera* is major pest of chickpea and it appears during the active vegetative growth with a pod formation. Chandra (2007) stated that population of spiders increased with the increase in population of hoppers and decreased with increase in temperature, wind, velocity, sunshine hour and rainfall.

CONFLICT OF INTEREST

Authors have no conflict of interest in particular subject.

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Table 1: List of spiders recorded in wheat and chickpea crops

Family	Species	Wheat	Chickpea
Araneidae (Clerck, 1757)	*1. Argiope anasuja* (Thorell, 1887)	+	+
	2. Cyclosa hexatuberculata (Tikader, 1982)	+	_
	3. Cyrtophora cicatrosa (Stoliczka, 1869)	_	+
	4. Neoscona mukerjei (Tikader, 1980)	+	+
	5. Poltys sp.	_	+
Cheiracanthiidae (Wagner, 1887)	*6. Cheiracanthium melanostomum* (Thorell, 1895)	+	_
Clubionidae (Wagner, 1887)	*7. Clubiona* sp.	+	+
Eresidae (C.L. Koch, 1845)	*8. Stegodyphus sarasinorum* (Karsch, 1892)	_	+
Hersilidae (Thorell, 1870)	*9. Hersilia savignyi* (Lucas, 1836)	+	+
Lycosidae (Sundevall, 1833)	*10. Lycosa* sp.	+	+
	11. Pardosa sp.	_	+
Oxyopidae (Thorell, 1870)	*12. Oxyopes javanus* (Thorell, 1887)	+	_
Pholcidae (C. L. Koch, 1850)	*13.Crossopriza lyoni* (Blackwall, 1867)	_	+
Philodromidae (Thorell, 1870)	*14. Philodromus sp.*	+	_
Salticidae (Blackwall, 1841)	*15. Hasariu sadansoni* (Audouin, 1826)	+	_
	16. Menemerusbivittatus(Dufour, 1831)	+	+
	17. Hyllus semicupreus(Simon, 1885)	_	+
	18. Plexippus paykulli (Audouin, 1826)	_	+
Sparassidae (Bertkau, 1872)	*19. Heteropoda venatoria* (Linnaeus, 1767)	_	+
Thomisidae (Sundevall, 1833)	*20. Xysticus sp.*	_	+
Total		**11**	**15**

Fig. 1: The survey site at Badodar village.

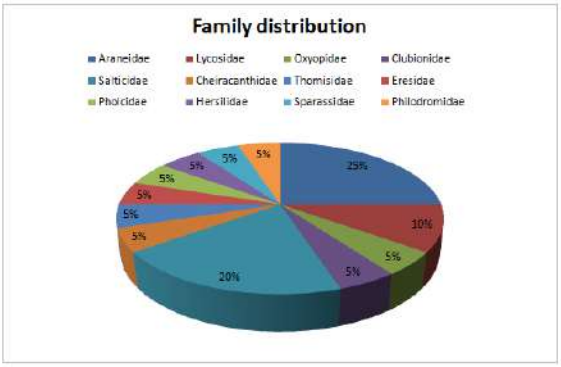

Figure 2: Spiders belonging to different families collected from Badodar

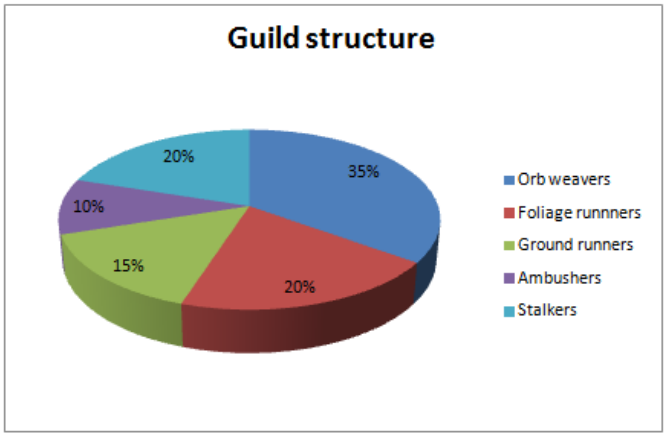

Fig.3: Guild percentage of observed spiders.

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RESEARCH ARTICLE

SQL vs NoSQL: The Emerging Technologies

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ABSTRACT

A data set is a coordinated assortment of organized data or information, normally put away electronically in a Computer System. An information base is normally constrained by a Database Management System (DBMS). At the time of selecting a database, it's ultimate to get with a relational (SQL) or non-relational (NoSQL) information structure. The two, are practicable alternatives, fortunately there are reasonable differences between the two datasets that consumers should consider when taking their choices. Sometimes, we hear statements such as "Did NoSQL put back SQL?", "SQL is outmoded?", "SQL is frequent used by most businesses", "this is the era of NoSQL,", and so on. Or 'on the other hand, is NoSQL simply a promotion?'. So, we will attempt to address every one of these questions in this paper.

Keywords: SQL, NoSQL, RDBMS, Database Management System, ACID, CAP, Oracle, MongoDB

INTRODUCTION

The experts state that the data on Earth is copied like a clockwork, which refers to the meaning that data doubles every two years. These large sites, such as Google, Facebook, Twitter, and even YouTube, generate large amounts of data regularly. Therefore, effectively saving and restoring this data is a tedious task. Increased exchange volumes and the aftermath of testing include organized capacity agreements, and datasets are the primary answer to address this issue of organized capacity and data recovery. Records are a way of storing data to make it possible to store and restore information at any time. SQL represents an organized query language that is usually constructed as an undeniable standard interaction point applied for most datasets known as DML and DDL in a relational database management system. Relational model datasets include MS-SQL Server, MySQL, Oracle databases, and more. Everyone uses SQL as the query language. NoSQL is a non-relational database management system like SQL. The

most commonly used NoSQL datasets include HBase, MongoDB, CouchDB, Cassan-Dra., and more. NoSQL datasets have evolved, led by top web organizations such as Amazon, Google, and LinkedIn, as the notoriety of "huge information" continues. The significant altercation between the SQL and the NoSQL states about the non-relational model generally has low consistency requirements and is designed to process large amounts of information at once. In the end, the restraint of ACID provided by many relational database systems has been relaxed in exchange for improved performance. In the white paper talk, we will narrow down the points of SQL and NoSQL to the correlation and execution benefits of NoSQL to SQL in the light of models and hypotheses, as well as the limitations arising from these variables. A relational database system(RDBMS or simply RDB) is a regular type of dataset in which data is managed in tables. It turns out that most of the datasets currently used as part of the association are relational information bases, not level document frameworks or other datasets. Relational datasets can manage large amounts of data and complex queries. Data is managed in partial and many tables or "relationships". These tables are divided into rows (records) and parts (fields). Anyway, as the amount of information has exploded, SQL-based data queries have become a major test for managing larger datasets. NoSQL datasets (originally called "non-SQL" or "non-relational") provide components for storing and restoring model information in a different way than the table joins used in relational datasets[1]. The essential goal of NoSQL development is to make it easy to store and retrieve information, regardless of its design or content. These are options that are respected rather than overcoming the limitations of today's immutable scenes that are overwhelmed by SQL and are thus also known as non-relational datasets. NoSQL systems are inherited, and non-relational datasets are expected to have huge amounts of data and significantly equivalent data managed between unpredictable servers. In addition, it uses languages and tools other than SQL to communicate with the data. These two types (SQL, and NoSQL) differ in many ways depending on the execution and can be used for equivalent applications, but are not recommended as one is not expected as an alternative to the other. This article focused primarily on SQL, NoSQL datasets, and the NoSQL information model, which collates and correlates between these two datasets (SQL, NoSQL).

RDBMS

Introduction of RDBMS

The technology used to store, manage, retrieve, and recover information put away in a relational database (dataset) is known as a relational database management system (RDBMS). The RDBMS gives a connection point among clients and applications and the data set, as well as managerial capabilities for overseeing information stockpiling, access, and performance. Data was initially put away in archives [2]. Nonetheless, as the amount of data expanded, getting to the data utilizing documents was difficult. It was a strategy that was slow and wasteful. As the amount of data developed, keeping the data and it was exceptionally hard to gather any records. Various levelled and network data sets were expected as instruments for capacity, however, they didn't give a typical method for information access. SQL appeared with the need to deal with data and the longing for a typical procedure for getting to data [3].

ACID Properties

At the point when a transaction system makes any exchange then the platform needs to guarantee that transaction will meet specific qualities. ACID is fundamental, yet just when the transaction is like sort of banking, finance, security frameworks, and so on that can be above for applications that need to share colossal measures of data like Google, Amazon, Facebook, etc. A transaction is a solitary legitimate unit of work that gets to and conceivably changes the items in a data set. Transaction access information utilizing read and compose activities. To keep up with consistency in a data set, when the exchange, certain properties are followed. These are called ACID properties [4][5]. Following are a few properties that should be satisfied when a transaction is made according to Figure 1. Atomicity: Each exchange is atomic mean toward say assuming one piece of the system bombs(fails) the whole system falls flat. A Transaction is an atomic unit of handling; it ought to either be acted completely or not performed by any means. Momentarily, the whole exchange happens immediately or doesn't occur by any stretch of the imagination.

Consistency: Each exchange is dependent upon a bunch of rules. An exchange ought to be consistency saving, intending that if it is executed from start to finish without obstruction from different exchanges(transaction), it ought

to take the data set starting with one predictable state and then onto the next. The information base should be reliable when the exchange.

Isolation: No exchange obstructs another exchange. An exchange ought to seem like it is being executed in disconnection from different exchanges, even though numerous exchanges are executing simultaneously. That is, the execution of exchange ought not to be impeded by some other exchanges executing simultaneously. Various exchanges happen autonomously without obstruction.

Durability: On the off chance that any individual is focused on the exchange, the other individual gets similar committed information. The progressions applied to the data set by a serious exchange should endure in the data set. These progressions should not be lost on account of any disappointment. The difference in an effective exchange happens regardless of whether the system disappointment happens.

Example

Firstly, refer to the Figure 2. A few instances of specific systems that utilize RDBMS are IBM, Prophet, MySQL, Microsoft SQLServer, and PostgreSQL [6].

NOSQL

Introduction of NoSQL

NoSQL databases (otherwise known as "not just SQL") are non-even information bases and store information uniquely in contrast to relational tables. NoSQL data sets arrive in various kinds in light of their information model. The primary kinds are document stored, column stored, key-value stored, and graph stored[2]. A NoSQL (initially alluding to "non-SQL" or "non-relational") data set gives a component to capacity and recovery of information that is displayed in implies other than the plain relations utilized in relational data sets. Such data sets have existed since the last part of the 1960s, yet the name "NoSQL" just began in the mid-21st hundred years, set off by the requirements of Web 2.0 organizations. NoSQL data sets are progressively utilized in large information and constant web applications[7][8]. NoSQL technologies are additionally at times called Not just SQL to underscore that they might uphold SQL-like question dialects or sit close by SQL data sets in multilingual steady designs.

For some of the following requirements, RDBMS does not follow qualifications:-

Distributed

Scalability

Control over performance characteristics

High availability

Low Latency

Cheap

Hence, to full fill, these requirements concept of NoSQL came into existence.

CAP Properties

The CAP hypothesis is a conviction from hypothetical software engineering about circulated information stores that cases, in case of an organization's disappointment on a dispersed data set, it is feasible to give either consistency or accessibility — however not both. NoSQL Data sets select two of the three CAP hypothesis standards (consistency, accessibility, and Partition tolerance) [9]. To accomplish better accessibility and dividing, numerous NoSQL information bases have released requests on consistency. This brought about a base system (fundamentally accessible, delicate state, eventually reliable). This infers that a trade-off can be made, for instance, either with low execution or proposition high openness and low consistency with fast execution[10].Refer to the Figure 3.

Consistency: Each read gets the latest composition or a mistake. Consistency implies that the hubs will have similar duplicates of a reproduced information thing noticeable for different exchanges. An assurance that each hub in a circulated group returns something similar, latest, and a fruitful compose. Consistency alludes to each client having a

similar perspective on the information. There are different sorts of consistency models. Consistency in CAP alludes to consecutive consistency, an extremely impressive type of consistency.

Availability: Availability implies that each perused or compose demand for an information thing will either be handled effectively or will get a message that the activity can't be finished. Each non-failing hub returns a reaction for all the read and composes demands in a sensible measure of time. The watchword here is "each". In basic terms, each hub (on one or the other side of an organization segment) should have the option to answer in a sensible measure of time. Each solicitation gets a (non-blunder) reaction - without ensuring that it contains the latest composition.

Partition tolerance: Partition tolerance implies that the framework can keep working regardless of whether the organization associating the hubs has a shortcoming that outcomes in at least two parts, where the hubs in each segment can impart among one another. That implies, that the framework proceeds to work and maintains its consistency ensuring disregarding network parts. Network parts are an unavoidable truth. Circulated frameworks ensuring allotment resilience can effortlessly recuperate from parts once the segment mends.

Based on the CAP hypothesis, different database picks a different combination of consistency, availability, and partition tolerance:
CA: Relational Database
CP, AP: Non-Relational Database

Examples
Key-Value Stored: Database depends upon the key is the best and ease to learn and understand among those four. The key in each record is equivalent to the essential key in SQL data sets, while the worth is a variety of information. The average key value data sets are BerkeleyDB, LevelDB, and Redis. A key-esteem data set, or key-value store, is an information stockpiling worldview intended for putting away, recovering, and overseeing cooperative clusters, and an information structure all the more generally referred to the present time as a word reference or hash table. Word references contain an assortment of items, or records, which thusly encapsulate various fields, each containing information. These records are put away and recovered utilizing a key that exceptionally distinguishes the record, and is utilized to track down the information inside the data set, refer to the figure 4.

Document Stored: The primary thought of the report arranged data set is the idea of the archive. Largely, well-known archives situated data set, MongoDB, utilizes the JSON design as its stockpiling. Document data sets are viewed as non-relational (or NoSQL) data sets. Rather than putting away information in fixed lines and segments, report data sets utilize adaptable records. Record data sets are the most famous option, in contrast, to even, relational data sets, refer to the figure 5.

Column stored: A segment situated data set stores tables by segments, rather than by lines. This distinction is essentially taken care of peruse/compose time (less is better) the data set oversee frameworks, meaning a section situated data set is for the most part viable with conventional column-based data set; the two of them can utilize SQL to stack information and perform an inquiry. Some illustration of section situated information bases is SAP HANA, Amazon Redshift, and Sybase level of intelligence. The section contains the name, value, and timestamp, so that is direct. The name/esteem pair is additionally straightforward, and the timestamp is the date and time the information was placed into the data set, refer to the figure 6.

Graph Stored: A diagram which is use to the store the data as database with edges, hubs and properties. Nodes address elements like individuals or organizations, while edges and properties address connections between substances. With the thought of diagrams, we can show information normally and store them at the rationale level. Instances of chart information bases are Allegro Graph and g Store. Each article can keep an assortment of different articles it is connected with. These references are typically pointers to objects in memory, and we don't need to

unequivocally store them. Nor do we need to track down the article in memory with some unfamiliar key characteristics, refer to the figure 7.

A few instances of specific systems that utilize NoSQL as a base are MongoDB, CouchDB, HBase, Redis, Riak, Neo4J, Couchbase, and Cassandra.

COMPARISON BETWEEN SQL AND NOSQL DATABASES

With regards to picking a data set the greatest choice is picking a relational (SQL) or non-relational (NoSQL) information structure. While both the data sets are practical choices still there are sure key contrasts between the two that clients should remember while settling on a choice. Structured Query language (SQL) articulated as "S-Q-L" or now and again as "See-Quel" is the standard language for managing relational Data sets or databases. A relational data set characterizes connections as tables. NoSQL is a non-relational DMS, that doesn't need a decent mapping, maintains a strategic distance from joins, and is not difficult to scale [11]. NoSQL information base is utilized for circulated information stores with humongous information stockpiling needs. NoSQL is utilized for huge information and ongoing web applications. For instance, organizations like Twitter, Facebook, and Google gather terabytes of client information each day.

The following is the fundamental contrast between NoSQL and SQL

Based on the definition, SQL data sets are essentially called RDBMS or relational Databases whereas NoSQL information bases are principally called non-relational or distributive databases. Based on Type, SQL data sets are table-based databases while NoSQL data sets can be a document stored, column stored, key-value stored, and graph stored. Based on Query Language, SQL refers to Structured query language (SQL) but NoSQL has no declarative query language.

In the discussion of suitability, an ideal decision for the mind-boggling question escalated environment. whereas NoSQL information base systems comprise different sorts of data set advances. These data sets were created because of the requests introduced for the advancement of modern platforms. It isn't a solid match for complex inquiries [12][13].

When we see the schema, SQL databases have a predefined schema and SQL data sets are upward scalable while NoSQL data sets utilize dynamic patterns for unstructured information NoSQL information bases are on a level plane versatile. SQL data sets are not appropriate for progressive information storage but NoSQL is More reasonable for the progressive information store as it upholds the key-esteem pair strategy.

Based on Properties, SQL follows ACID (atomicity, consistency, isolation, and durability) but NoSQL follows CAP which stands for consistency, accessibility, and Partition tolerance. While looking at Examples, SQL has MySQL, PostgreSQL, Oracle, MS-SQL Server, etc. whereas NoSQL has MongoDB, GraphQL, HBase, Neo4j, Cassandra, etc [14]. Differences between Terminologies used in SQL & NoSQL are refer to the table 1. Brief Differences between queries of SQL and NoSQL are refer tot the table 2.

Benefits of RDBMS (SQL) and NoSQL over each other

SQL advanatges over NoSQl

It's easy to learn, use and operate.
Simple to configure, execute, keep up with and use.
One of the principal benefits of RDBMS is that the main data is saved in one place.
It offers various points of interaction and interfaces.
It works on the uprightness of data.
It is too much secure by its nature.
It has standard query language.

No SQL advanatges over SQL

Gives a wide choice of data models.
Effectively adaptable.
Directors of the information base or database are not essential.
Some NoSQL DB providers, for example, Riak and Cassandra can repair hardware failure.
Quicker, more productive, and adaptable.
Has grown quickly.
Utilized generally for big data applications.

Drawabacks of RDBMS (SQL) and NoSQL over each other

SQL disadavatges over NoSQl

Programming, Technologies, and software are costly.
Equipment overheads
Restrictions in Construction
The lost information can scarcely be recuperated.
High accessibility issue
Not help Large Information applications
Certain applications are delayed in handling.

NoSQL disadavatges over SQL

Imperfect (immature).
No standard query language.
The ACID similarity is unimaginable in some NoSQL data sets.
No point of interaction in particular.
It is difficult to keep up with.
Less help.

CONCLUSION

The decision between SQL and NoSQL relies totally upon individual conditions as the two of them enjoy benefits as well as burdens. SQL databases are for some time laid out with fixed pattern plans and set construction. They are great for applications that require multi-line exchanges like a bookkeeping platform or for inheritance frameworks that worked for a relational structure. On the other hand, NoSQL data sets are effectively versatile, adaptable, and easy to use as they have no unbending diagram [15][16]. They are great for applications with no particular mapping definitions, for example, satisfied administration frameworks, large information applications, continuous investigation, and so on. SQL information bases, for the explanation that they are connection situated, enjoy benefits of vertical adaptability and solid consistency [17]. As consistency is focused on in SQL data sets, the data set oversees framework needs to accomplish bunches of tasks to keep up with the steady state, which will think twice about execution. NoSQL data sets, as they are intended to be adaptable and quick, have fewer limitations than SQL by decreasing the above consistency. Concerning adaptability, NoSQL can store information in a few sorts like items (records or key-esteem pair) conveyed. Concerning speed, NoSQL is by and large quicker than SQL, particularly for key-esteem capacity in our analysis; Then again, the NoSQL data set may not completely support Corrosive exchanges, which might result from information irregularity.

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Table 1. Terminologies in SQL & corresponding in MongoDB

SQL	NoSQL
Table	Collection
Primary key (specify any unique column or column combinations as primary key)	Primary key (the primary key is automatically set to the _id field in MongoDB)
Table joins	Embedded documents and linking
Row	Document or BSON document
Column	Field
Aggregation (e.g., by group)	Aggregation pipeline
Index	Index

Table 2. Difference between queries of SQL and NoSQL

On the basis of	Oracle SQL (SQL)	MongoDB (NoSQL)
Select	Select * from student	db.student.find()
Insert	INSERT INTO Customers (id, studentName, Age,City, PostalCode, Country) VALUES ('1','veetrag','19','indore','452010','india');	db.student.insert(id: "1",name : "veetrag", Age: "19", city : "Indore", PostalCode: "452010", country "India")
Create	Create Table student (id int, studentname varchar (20), age int, city varchar (20), postalcode int, country varchar(20))	db.create Collection ("student")
Drop	DROP TABLE student	db.student.drop()

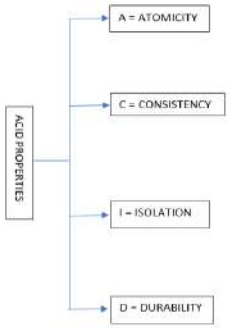

Figure 1: ACID Properties

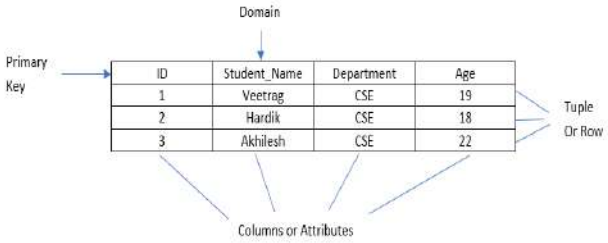

Figure 2: Data Store in the form of Table

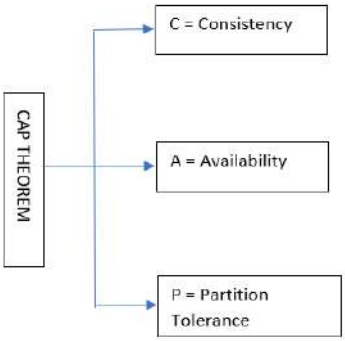

Figure 3: CAP Propertie

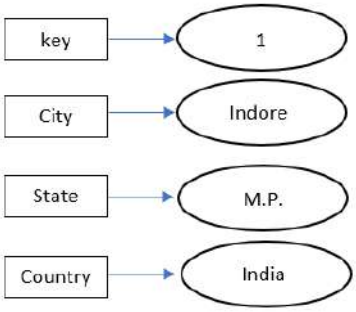

Figure 4: Key- Value Stored

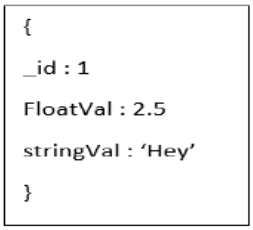

Figure 5: Document- Value Stored

Columns	Value
Id	1;..
floatVal	2.3;..
stringVal	"Hey";..

Figure 6: Column- Value Stored

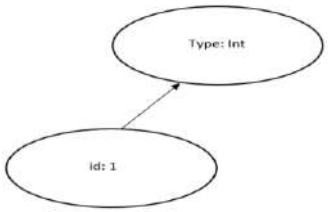

Figure 7: Graph- Value Stored

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REVIEW ARTICLE

Melioidosis – an Overview in the Context of Bacterial Infections

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ABSTRACT

Burkholderia pseudomonellei (BP) is a gram negative, bipolar aerobic motile rod shaped bacteria, it is a soil dwelling bacteria endemic in tropical and sub tropical regions particularly in Australia and Thailand. It was discovered by Alfred Whitmore and CS Krishnaswami in opium addicts in rangoon in 1911. It infects humans and animals and cause the disease Melioidosis or white mores disease. Media in which *Burkholderia pseudomonellei* grows are sheep blood agar, Mac-Conkey agar, Ash downs medium. Infection can occur through skin inoculation, inhalation and injection. Signs and symptoms include cough with normal sputum or non productive cough, high fever due to the release of pro inflammatory mediators, headache and general muscle weakness. BP can remain dormant in humans for a prolonged period. Organs affected are liver, spleen, lungs, prostrate and kidney of patients with diabetes, renal stones, thalassemia or severe burns. Disease may present years or decades after initial exposure. The organism is often misidentified by methods used routinely in clinical laboratories. Investigations include culture of blood, sputum, pus, indirect hem agglutination. *B.pseudomonellei* is difficult to treat. Ceftazidine 100mg/kg(2g 3 times daily), Imipenem 50mg/kg(1g 4 times daily), Meropenem(0.5-1g 3 times daily)is given for 2 to 3 weeks. This is followed by maintenance of therapy of doxycycline 200mg daily with cotrimazole for a minimum of 12 weeks.

Keywords: *Burkholderia pseudomonellei*, Melioidosis, Tropical diseases, Bacterial infection.

INTRODUCTION

Melioidosis an infectious disease which is of great public health importance in Southeast Asia and Northern Australia with high case fatality rates in animals and humans[2]. Melioidosis is a tropical bacterial infection, rarely encountered and poorly known by clinician. The mortality burden is similar to that of measeles. Melioidosis is extremely rare in the temperate zone, there are especially imported cases by travellers or imigrants. Melioidosis is unknown to non - endemic areas and it can easily mistaken for other diseases like community acquired pneumonia or tuberculosis so it is often referred to as " Great Mimicker" . Melioidosis often commonly occurs in individuals with one or more pre-existing condition associated with altered immune response [1]. It is caused by an environmental saprophyte gram negative bacteria found in wet soil called *B.Pseudomonallei.*

Melioidosis was found out by young and enthusiastic pathologist Alfred Whitmore and his assistant K.S Krishnaswami as glanders like disease among morphia addicts rangoon, Burma in 1911 [6]. They distinguish B. pseudomonelleifrom the organism causing glanders disease by its relative rapid growth, its motility and lack of strains when injected in guinea pig [15]. Melioidosis causes a clinical spectrum of symptoms ranging from pneumonia/ cutaneous infection to filminant septicemia and also important cause of community acquired sepsis in Southeast Asian and Northern Australia which accounts from 40% death in treated patients [16]. Recent studies highlight that India is an endemic region for *B.pseudomonellei.* Advances in science help in better and early management of infectious disease which resulted in reduced mortality and economic burden on patient and health care facility[7].Laboratory identification of *B.pseudomonellei* required specialized techniques beyond that available in many routine diagnostic microbiology laboratories, So meliodosis remain undiagnosed or are delayed in diagnosis [10].

Management of melioidosis require antibiotic therapy, which should be commenced immediately on suspicious of the diagnosis of melioidosis. Ideally culture should be performed prior to administration of antibiotics but treatment should not be delayed if culture cannot be performed rapidly[2]. Suspectability testing for most commonly used antimicrobial agents should be done using appropriate guidlines, This includes Doxycycline, Ceftazidine, Meropenum, Amoxicillin- clavulate and treatment should be given accordingly [11].

In this review we are discussing: History, Epidermiology, Risk Factors, Pathophysiology, Signs and symptoms, Diagnosis and Treatment of melioidosis.

History

Melioidosis was first discovered in 1911 by the pathologist Alfred Whitmore and C. S Krishna swami among morphia addicts in humans. It was described initially as glanders- like disease. However, the bacterium isolated from autopsy specimen was distinguished from the organism causing glanders due to its relatively rapid growth, motility, and the lack of the Strauss reaction when it was injected into guinea pigs[17]. The new bacterial infection was characterized by widespread consolidation of lungs, classically with abscesses in the liver, spleen, kidney and subcutaneous tissues[5].They correctly summarised that this new bacterium was closely related to that which caused glanders, a finding that has only recently been confirmed by molecular studies [18]. *B. cepacian* is the type of species, which includes the organism causing Melioidosis (*B.pseudomonellei*) and glanders (*B.mallei*). A number of additional related environmental bacterial species have subsequently been discovered and added to the *Burkholderia genus*[8].

This disease, now termed Melioidosis, was named from the Greek “melis” (distemper of asses) and “eidos” (resemblance) by Stanton and Fletcher in 1932[19]. During the last century this gram-negative environmental bacterium has been variously known as *Bacillus pseudomonellei, Bacillus whitmore (or Bacille de whitmore), Malleomyces pseudomonellei, Pseudomonas pseudomallei,* and since 1992as *B. pseudomallei.*

In the latter half of the 20th century, melioidosis emerged as an infectious disease of major public health importance in Southeast Asia and northern Australia[20]. In Ubon Ratchathani, Thailand, *B. pseudomonellei* accounts for up to approximately 20% of community-acquired bacteremias. At the Royal Darwin Hospital, Australia, it has been the most common cause of fatal community-acquired bacteremic pneumonia [7].

Largely due to clinical trials in Thailand, significant improvements have been made in defining the optimal antibiotic therapy for Melioidosis. However, the choice of antibiotic regimen has not been shown to have an impact on mortality within the first 48 h of admission, and severe Melioidosis in Thailand is still associated with a case fatality rate of approximately 50%[21]. In Australia, the mortality rate is still significant and approaches 20% among all patients with Melioidosis [6].

The epidemiological distribution of Melioidosis in various countries:

The disease is highly seasonal 75 to 85% of cases presenting during the rainy season and clusters have been reported in association with severe weather such as typhoon [22]. Meliodiosis is more common in people who have close contact with soil and water. The majority of cases were described in 2005 after the Indian Ocean tsunami [11].

Thailand

Thailand is the best example of increasing recognisation of Melioidosis within an endemic area. Despite the diagnosis of an imported case in 1928 and two cases in prisoners of war in 1947 , the first case was not reported until 1955. Other centres in the North East Thiland such as KhonKhea, Buri Ram also has large number of patients[23]. In Thailand *B.pseudomonallai* is widely distributed in soil particularly in cooled surface water such as in rice paddies[1].

Indian Sub Continent

Cases of human Melioidosis have been reported from several Indian states including Maharastra, Kerala , Orissa, Tripura[24]. Imported Melioidosis in the UK act as a mirror on the rest of the world and provides further evidence that Melioidosis is widely distributed in the Indian Sub Continent. From 15 cases diagnosed in Uk between 1988 and 1998, five originated from Bangladesh and each one from India and Pakistan[3].

China

B. pseudomonellei which was previously known to be endemic in Hong Kong had been repeatedly been isolated from the environment in the island of Hainan and Southern provinces[25].

Sub- Saharan Africa

There is a little evidence of Melioidosis activity in Sub- Saharan Africa. An environmental survey in Kenya yield no isolates of typical pseudomonelleifrom152 soil and water samples [6].

Middle East

There have been several isolations of B. pseudomonellei reported from Middle East in the last few years but none of them was independently identified accurately[8].

The American and caribean

The carribean is regarded as endemic for Melioidosis, although further work is needed to determine how common the disease is[26].

Singapore

In singapore , recent overall annual Melioidosis incidence rate was 1.1 per 1 lakh population. Males are found to be more affected which can possibly be due to the involvement in occupational and recreational activities [27]. Systemic Melioidosis primarily affects older individuals with underlying medical conditions. The highest incidence was reported in people more than 45 years old. People with renal impairment also has more risk of infections. In singapore , the major systemic presentation are bacteremia, deep organ involvement , deep organ abscess and

pneumonia. Several antimicrobial regimen containing *B. pseudomonellei* active agents (Ceftazidime or Carbapenem) has been utilized for treatment of community accquired pneumonia in Singapore ICU[28]. Localized soft tissue infections have been seen, it has been due to local trauma or innoculation. These patients do not have diabetes or compromised immunity[29]. In 2006, there was a case of *Melioidosis osteomylitis* reported in singapore in a 32 year old diabetic man who also has infection in spleen and liver. Successful treatment was established with drainage coupled with antibiotics [9].

Risk factors

Melioidosis mainly affect paddy farmers and their families. It is recognised that Melioidosis is a more significant global health concern. The major risk factors for Melioidosis are chronic lung disease, chronic kidney disease, thalassemia (which probably causes neutrophil dysfunction due to iron overload), history of trauma or surgery, hematologic malignancy, or solid tumor, pulmonary tuberculosis [6]. Other known risk factors include, age>45 years, exposure to soil and water (especially during rainy season), Malesex (due to greater risk of environmental exposure)[7]. Immuno suppression and steroid use can also predispose individuals to infection. Melioidosis is more common in diabetic and chronic kidney failure patients may be due to neutrophil dysfunction (impaired chemotaxis, phagocytosis and killing)[30]. This confirms that impairement of host immunity plays a major role in the pathogenesis of Melioidosis .Some environmental factors such as severe whether events and quantum of 14 day rainfall prior to the onset of clinical illness has been shown to be an indendent risk factor for increased incidence of Melioidosis as well as severity of related septicemia [31]. Melioidosis can also occur when doing sporting activities on wet ,muddy sport fields. Melioidosis in adult patients who have no recognized risk factors is due to high bacterial overload, for example by aspiration of surface water [32]. However, Zoonotic transmission is rare and only three possible cases are reported in Australia [4].

Patho physiology

In terms of pathogenesis, Melioidosis is a fascinating infection. *B.pseudomonellei*, like many other soil bacteria, is difficult to eradicate. Despite this, it has the ability to transcend its saprophytic form in the environment and become a human and animal disease [33]. The host pathogen interaction might result in anything from asymptomatic sero conversion to swiftly deadly and fulminant sepsis. Between these two extremes, the infection may have a chronic or relapsing course, or it may remain latent for years before becoming active again[34]. The amount of the inoculum, the virulence of the infecting strain, and the sensitivity of the host are all factors that will influence the outcome [6]. The mucoid colonial morphology suggests that there is a presence of slime or extracellular polysaccharide layer on *B. pseudomonellei* [35]. Ruthenium-red stained preparations of bacterial cultures viewed by electron microscopy revealed three morphologically distinct variants; one with a very marked and another with a less electron-dense layer surrounding the cell wall, and a third varient devoid of such a structure[5]. It produces a highly hydrated glycocalyx polysaccharide capsule, an important virulence determinant that helps to form slime. This capsule facilitates the formation of microcolonies in which the organism is protected from antibiotic penetration [36].

There are many studies conducted on the transmission electron microscopy to study the internalisation of traditional phagocytosis of *B.pseudomonellei* by human macrophages within membrane-bound phagosomes [37].It had also shown that that phagolysosome fusion occurred slowly and inefficiently in monocytes of patients with Melioidosis, leading to an increased number of intracellular organisms compared with monocytes obtained from healthy donors [2]. The data also suggest that a tiny number of *B.pseudomonellei* are able to defeat the human host cell's microbicidal arsenal, persist and grow, or remain inert in a dormant condition, allowing for recurrence at a later time[9].

Nitric oxide, a primary microbicidal mechanism in phagocytic cells, is cytotoxic and inhibits the reproduction of many intracellular pathogens when combined with other reactive nitrogen intermediates created during the respiratory burst [38]. The formation of 8-iso-PGF2, a bioactive product of free radical-induced lipid peroxidation, can be used to measure macrophage activation. When macrophages obtained from Melioidosis patients and normal patients are compared patients with Melioidosis generate significantly lower levels of nitric oxide and 8-iso-PGF2α compared to macrophages obtained from normal subjects [39].

B.pseudomonellei produce a number of virulence factors that may contribute to the progression of disease: protease, catalases, peroxidases, superoxide dismutase, lipase, phospholipase C (lecithinase) and hemolysins as well as at least one siderophore. Cell-associated virulence determinants, quorum sensing, type III secretion systems and flagella have also been implicated[40].Resistance to complement-mediated bacteriolysis is also a key virulence determinant. *B.pseudomonellei* produce a humoral antibody response during all stages of the disease including asymptomatic seroconversion. Strong IgG, IgA and IgM responses were produced by Melioidosis patients to the culture filtrate antigen throughout the infection. Analysis of IgG isotypes demonstrated that IgG1 followed by IgG2 were the predominant subclasses involved in the humoral response [41]. These studies provide evidence that monitoring either IgG or IgG+IgM antibody levels in patients under maintenance /eradication therapy may be useful as a guideline to determine the duration of this therapy. It has been recognised that serodiagnosis is problematic in areas of endemicity due to background seropositivity. It has been demonstrated that if a suitable cut-off titre is used to exclude background antibody levels, then a sensitive and specific serological test can lend support to the diagnosis of Melioidosis[10].

Diagnosis

Isolation of *B. pseudomonellei* from bodily fluids of patients remains the "gold standard" in diagnosis and it requires the use of selective media for nonsterile specimens. A number of techniques have been employed to attempt to reduce the time required to achieve a diagnosis, including antigen detection on specimens or on culture supernatant, antibody detection, molecular techniques, and rapid culture techniques. Only some of these tests have been used now a days clinically[7].On patients suspected of having Melioidosis, microbial cultures of rectal and throat swabs deposited in Ashdowns selective medium are beneficial. In Thailand, direct immunofluroscence microscopy of contaminated bodily fluid enabled for diagnosis in 30 minutes with 98 percent specificity and 70% sensitivity[42]. However, this approach is no longer commercially available. Abdominal ultrasound is the recommended options for children to minimize radiation exposure[11].

Symptoms of Melioidosis

Melioidosis can manifest itself in a variety of clinical signs and symptoms. There could be a lengthy period between the causative agent's exposure and the clinical and infection manifestations. The longest documented incubation period is 62 years [2]. Based on the type of infection Melioidosis can be of three types pulmonary (lung), bloodstream, local and disseminated infections. The symptoms also vary depending on the type of infection. In general, it takes two to four weeks for the development of symptoms after exposure to bacterium. However, in some people the disease is dormant without symptoms [12].

Pulmonary infection

Lung infection is the most common mode of Melioidosis infection. A lung infection can be either a direct infection or a result of blood infection. Nature of infection can be either, mild, causing bronchitis or severe leading to pneumonia and septic shock [43]. Symptoms of pulmonary Melioidosis infection are similar to that of tuberculosis. They both can lead to pneumonia, high fever, pus or blood in the lung tissues [14]. X-ray of lung infected by Melioidosis may or may not have empty spaces, cavitations which is a characteristic of tuberculosis.

Bloodstream Infection

Pulmonary infections if left or untreated can progress to septicemia and is life threatening Blood stream infection is risky for people with specific conditions such as: Diabetes, Kidney disease, Alcohol abuse, Liver disease, Thalassemia, Chronic lung infections including cystic fibrosis, COPD (Chronic obstructive pulmonary disease) and bronchiectasis [13].

Symptoms

Pulmonary infection	Blood Stream Infection
Cough with normal sputum	Fever especially with shivers and sweating
Chest pain during breathing	Headache
High fever	Sore throat
Headache and general muscle soreness	Diarrhea
Weight loss	Disorientation

In vitro, carbapenems are the most effective antibiotics against *B. pseudomonellei*. There are also some theoretical grounds to believe they could be more effective than ceftazidime in treating infections with prolonged post-antibiotic effects and quick onset of activity.

Eradication phase

A minimum of 12 weeks of therapy is recommended. As better therapy of the acute phase resulted in a higher number of survivors, it became more vital to find regimens that would minimise relapses. The agent and length of oral treatment are the most relevant risk variables for genuine recurrence, followed by positive blood cultures and multifocal infection, according to multivariate analysis [13]. If the organism is susceptible and the patient does not have a documented allergy to it, oral co-trimoxazole is the agent of first choice..Co-amoxiclav is the second-line option if the organism is resistant to co-trimoxazole or the patient is intolerant. Depending on the source country, co-amoxiclav is available in various ratios and formulations[14].

The traditional regimen (chloramphenicol plus doxycycline plus co-trimoxazole) was always associated with a significant risk of adverse effects, and there was some in vitro evidence of reciprocal antagonism between these medicines, as well as the possibility of resistance emerging to all of them at the same time. Patients who received co-amoxiclav (10%) for more than 12 weeks had a greater relapse rate than those who received standard treatment (4.9%), albeit none of these differences were statistically significant[48]. Multifocal illness was linked to a higher likelihood of relapse, as did poor compliance. Co-amoxiclav, on the other hand, was more tolerated than the standard regimen, which was linked to side effects in 29% of cases[10].

Adjunctive treatment

Obviously patient management should always include the optimal supportive treatment for sepsis available, including maintenance of blood pressure, adequate glycaemic control, and management of respiratory and acute renal failure as well as drainage of abscesses where possible[11]. Because the overall mortality of patients with severe Melioidosis remains high, and many of those who die do so within the first 48 hours of treatment, when antibiotics are unlikely to make a difference, various approaches to interrupt the inflammatory cascades and pathogenic processes that lead to death, or to augment host defences, have been tried[49]. The platelet-activating factor receptor antagonist lexipafant was used in the first research. The study included 131 adult Thai patients with suspected sepsis who were randomized to receive lexipafant or placebo for up to 7 days, of whom 66 had positive blood cultures, 36 of which were *B. pseudomallei*. However, no differences in mortality at 28 days or any of the clinical or laboratory characteristics examined were found between the groups. Steroids and activated protein C have also been utilised in individuals with melioidosis-related sepsis but have never been studied prospectively, and their effect, like that of sepsis in general, is unknown[7].

Prophylaxis

Duration of post-exposure prophylaxis is 21 days. If the organism is susceptible and the patient does not have a documented allergy to it, oral co-trimoxazole is the agent of first choice Oral co-trimoxazole is the primary choice if the organism is sensitive and the patient does not have a confirmed allergy to it. Co-amoxiclav is the second-line option if the organism is resistant to co-trimoxazole or the patient is intolerant[3]. The possibility of laboratory

workers contracting Melioidosis and usage of B. pseudomallei as a bio weapon are the two main reasons for interest in melioidosis prophylaxis. Although just two cases of laboratory-acquired melioidosis have been documented[50].

CONCLUSION

Meliodiosis is an infectious disease caused by *B.pseudomonellei* which was earlier confined to South East Asia and northern Australia. However, recently cases have been reported on various parts of the world especially in the Indian Sub Continent. The similarity in presentation of the disease with TB and the lack of awareness among physicians make identification of Meliodiosis difficult . Delay in proper treatment leads to septicemia and eventually death. The recalcitrant nature of melioidosis with its tendency to recurrence, leads to the nickname for this disease as 'The Vietnam time bomb'. The possibility of using *B. pseudomonellei* as a bio weapon is also a matter of concern apart from the recent spread of *B.pseudomonellei* infection. The most effective treatment for *B.pseudomonellei* is early diagnosis and a strict antibiotic regimen. Co-trimoxazole, Co-amoxiclav, Ceftazidime and Trimethoprim are the drugs of choice for various conditions of Meliodiosis treatment. A vaccination programme against *B. pseudomonallei* may be an effective preventive measure in the coming future. As melioidosis mainly affect paddy farmers, and their families they can be the most important target population for the vaccine trial. Prophylactic vaccines are an attractive alternative to protect against Burkholderia infections. The correlation of protection from both acute and chronic infection is the most major issue facing *B. mallei* and *B. pseudomonellei* vaccine development.

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Table 1:Initial acute-phase therapy for melioidosis

Drug	Patient characteristics	Recommended dosage/frequency
Trimethoprim / sulfamethoxazole (co-trimoxazole)[b]	Adult, >60 kg	160 mg/800 mg tablets; two tablets every 12 h
	Adult, 40–60 kg	80 mg/400 mg tablets; three tablets every 12 h
	Adult, <40 kg	160 mg/800 mg tablets; one tablet every 12 h OR
		80 mg/400 mg tablets; two tablets every 12 h
	Child	8 mg/40 mg per kg; maximum dose 320 mg/1600 mg every 12 h
OR		
Amoxicillin/clavulanic acid (co-amoxiclav)	Adult, >60 kg	500 mg/125 mg tablets; three tablets every 8 h [c]
	Adult, <60 kg	500 mg/125 mg tablets; two tablets every 8 h [c]
	Child	20 mg/5 mg per kg every 8 h; maximum dose 1000 mg/250 mg every 8 h

Table 2:Oral eradication-phase therapy for melioidosis

Drug	Recommended dosage/frequency
Ceftazidime	50mg/kg of body weight(upto 2 g), every 6 hrs
Meropenem	25 mg/kg(upto 1 g), every 8 hr
Trimethoprim + Sulfamethoxazole (TMP+ SMX)	8/40 mg/kg (upto 320+1600mg)every 12 hr for atleast 3 months, close follow up and monitoring of adherance required

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REVIEW ARTICLE

Therapeutic Potential of Citrus Flavonoid Naringin against Colorectal Cancer: Recent Findings and Future Perspectives

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ABSTRACT

Naringin is an important citrus flavonoid. It is now well known for its various biological activities and also for its immense therapeutic potential. Naringin have anti-proliferative, anti-inflammatory and anti-oxidant potential along with other properties. Naringin has been investigated for its role against CRC and found to be promising. Also, naringin have potential to be used as therapeutic agent for the prevention of ulcerative colitis and colorectal tumor. CRC is affecting a significantly large population world wide. Researchers have shown keen interest in flavonoids for management of different cancers. Naringin has emerged as flavonoid of interest against CRC as part of effective and alternate treatment. Limited literature is available but still, naringin seems promising therapeutic candidate against CRC. More research in the area is required for naringin based safe and effective management of CRC. This review provides concise and updated information on therapeutic role of citrus flavonoid naringin against colorectal cancer (CRC). This review presents the recent studies and mechanisms dealing with protective effect of naringin against CRC.

Keywords: Flavonoid; naringin; anti-proliferative; anti-inflammatory; colorectal cancer

INTRODUCTION

Flavonoids are important category of secondary metabolites. These are abundantly present in plants and serve as important source of bioactive compounds [1, 2]. In recent, dietary flavonoids have emerged as a safe, effective and alternate way of treating or managing the various diseases including cancer [3; 4]. Various plants based functional foods have been proved effective and beneficial for human health due to presence of flavonoids [4; 5; 6]. Naringin is a flavonoid naturally present in citrus fruits. It is known to contribute bitter taste to citrus juices. Naringin is well known for its various biological activities and has been investigated for its therapeutic potential [7; 8]. It has been found effective against various diseases. It has been reported to have biological activities including antimicrobial potential, anti-inflammatory activity, anti-oxidant property, anti-cancerous activity, anti-ulcer role, management of osteoporosis, and numerous other properties [2; 5, 7-8]. Naringin has also been shown to have hepatoprotective, cardioprotective and renoprotective properties [2, 5, 9-10]. The effect of naringin on osteogenesis, controlled medication discharge, bone recovery, osteoporosis, osteoblasts, metabolic condition, chromosomal damage, oxidative damage, neurological disorders and sensory system issue have been investigated [2, 5, 7-18]. Naringin has also been found effective against specific cancers including colorectal cancer (CRC). Colorectal cancer is among the most common cancers affecting humans worldwide [19; 20]. A large number of deaths are reported from this disease every year [20; 21] and incidence of colorectal cancer (CRC) has increased in recent times [22]. It become very important to focus the research on the new treatment/ alternate treatment or combination based treatment methods for CRC. Flavonoids are of particular interest to be part of effective and alternate treatment or in combination with various therapeutic molecules/ processes [22]. Flavonoids are promising molecules for prevention as well as management of various cancers including colon cancer. Falvonoids are safe, naturally present in various plant parts and easily available. Naringin is one of the flavonoids well known for various biological activities and therapeutic potential. Researchers found it very promising in prevention as well as management of several diseases. Researchers have investigated the naringin for its role against the colorectal cancer. It has been found to be interesting molecule that needs more elaborated research and clinical trials. This review focuses on the effectiveness of naringin against the CRC, mechanism of action and future perspectives.

Therapeutic potential of naringin against colorectal cancer (CRC): Recent findings and mechanistic insight

Naringin has been reported for its anti-proliferative and ant-cancerous property. It has also been investigated for its effect against the colorectal cancer (CRC) cells and related aspects **(Figure 1)**. The inhibitory effect of naringin on proliferation of CRC cells by inhibiting the PI3K/AKT/mTOR signaling pathway [22]. Researchers used the MTT assays to detect the proliferation of CRC cells treated with various concentrations of naringin. They detected the degree of apoptosis and also the expression of apoptosis-related proteins (Bcl-2 and Bax) in CRC cells stimulated by naringin using flow cytometry and western blot assays, respectively. Further, the expression levels of PI3K/AKT/mTOR-related proteins [PI3K, AKT, mTOR, phosphorylated (p)-PI3K, p-AKT and p-mTOR] were detected after stimulation of CRC cells with naringin. It was found that naringin inhibited the proliferation of CRC cells in a dose-dependent manner. Naringin was found to promote the apoptosis of CRC cells and it inhibited the activation of the PI3K/AKT/mTOR signaling pathway (in a dose-dependent manner). On the basis of results, authors suggested that naringin may be a promising therapeutic agent for the treatment of CRC [22]. Elansary et al. [23] have recently reported the presence of naringin in methanolic leaf extract from natural *Mentha piperita.* Researchers also reported the antiproliferative activity of naringin against HT-29 colon adenocarcinoma cell lines (Elansary et al., 2020). In a study by Chidambara Murthy et al. [24], structurally similar flavonoids of citrus including naringin were shown to differentially inhibit the human colon cancer cells. In a study carried by Ugocasi et al. [25], the effects of various flavonoids and carotenoids on the reversal of the multidrug resistance (MDR) of Colo 320 cells were studied. Among the tested flavonoids, naringin was found to have marginal effect. The flavonoid naringin also induced the apoptosis in Colo 205 and Colo 320 human colon cancer cells [25]. Ghanbari-Movahed et al. [26] recently presented a systematic review on the therapeutic and preventive effects of naringin on human malignancies. Authors also summarized the potential of naringin against colon cancer. In a study by Shen et al. [27], it has been found, on the basis of MTT assay, that flavanones with different numbers of OH substitutions exhibited differential cytotoxicities

in various colorectal carcinoma cell lines (COLO205, HT29, and COLO320HSR). The flavanones with more than one OH substitution including naringenin and naringin had no significant cytotoxicity to these selected cells lines [27]. The effect of naringin on the tumor line HT29 has also been investigated [28]. Naringin was found to be anti-proliferative in dose dependent manner against HT29 cell lines. Further, authors presented the results that the bio-transformed naringin also has anti-proliferative effect on the selected cell line (HT29).

In recent years, the research suggests that combination therapy is effective for a selective chemotherapeutic effect in the treatment of colon cancer [29]. Recently, Albayrak et al. [29] reported that naringin combined with NF-κB inhibition and endoplasmic reticulum stress stimulates apoptotic cell death via oxidative stress and the PERK/eIF2α/ATF4/CHOP axis in HT29 colon cancer cells. Authors investigated the death of colon cancer HT29 cells and also healthy vascular smooth muscle TG-Ha-VSMC cells (VSMCs) induced by naringin combined with endoplasmic reticulum (ER) stress and NF-κB inhibition. It was found that naringin combined with tunicamycin and BAY 11-7082 resulted in suppression of HT29 cells proliferation in a dose-dependent manner and also induced the apoptotic death without affecting the healthy VSMCs significantly. Naringin combined with tunicamycin and BAY 11-7082 effectively induced the apoptotic cell death in HT29 colon cancer cells through oxidative stress and the PERK/eIF2α/ATF4/CHOP pathway. On the basis of results, authors suggested that naringin in combination with tunicamycin plus BAY 11-7082 may be a new combination therapy based strategy for effective colon cancer treatment with minimal side effects on healthy cells [29]. Cytotoxic activity of naringin and its synthesized platinum and vanadium metal complexes have been reported against the HCT116 (human colorectal carcinoma) cancer cell line [30]. The antitumor activity of naringin and in hybrid with specific conjugates (SCMC-PA and SC-PA) against colon HCT116 has been reported by Basta et al. [31].

Grapefruit pulps, naringin and limonin have been investigated for protection against the azoxymethane (AOM)-induced aberrant crypt foci (ACF) in Sprague–Dawley rats by suppression of proliferation and elevation of apoptosis [32]. Apoptosis levels in AOM injected rats provided with untreated grapefruit, naringin and limonin were found to be greater as compared to saline-injected rats. Also, naringin reduced the tumor cell proliferation [32]. Also, in a study carried by Zhang et al. [33], naringin was found to prevent the azoxymethane (AOM)/ dextran sodium sulfate (DSS) induced chronic colorectal inflammation and carcinogenesis in male C57BL/6 mice. Naringin was administered by orally and it prevented AOM/DSS-induced ulcerative colitis and carcinogenesis without resulting in significant side effects. Authors reported that naringin attenuated the severity of colitis and colorectal adenomas through inhibition of myeloid derived suppressor cells (MDSCs), pro-inflammatory mediators and the NFκB/IL-6/STAT3 cascades in colorectal tissues [33]. Naringin prevented colitis and colorectal carcinogenesis through suppressing robust ER stress induced autophagy in colorectal mucosal cells. The mechanisms of chemopreventive effects were associated with its multiple biological activities including anti-inflammation, anti-proliferation and prevention of the ER stress-induced autophagy in colorectal epithelium [33]. Naringin could develop a promising therapeutic agent for the prevention of ulcerative colitis and colorectal tumor [33]. Colorectal cancer (CRC) is affecting the significant number of humans and also causing death. It is among the most commonly diagnosed cancers throughout the world and causing a significant burden in terms of morbidity and mortality [34]. It turned very important to emphasize on the research for safe and effective new treatment/ alternate treatment or combination based treatment methods for CRC. Flavonoids are of particular interest due to their advantages as safe, natural and effective in management of various diseases including cancer. Flavonoids also emerged as effective molecules against CRC. Naringin is one of the promising citrus flavonoid that has been studied for its role against CRC. Various researchers presented as effective agent against CRC along with mechanistic insight. More elaborated research is required to support the potential of naringin against the CRC.

Conclusion and Future Perspectives

Colorectal cancer (CRC) has turned a major health problem. The cases are increasing significantly along with annual deaths. Researchers are working on finding safe, effective, alternative or combinatorial treatment strategy for CRC. Flavonoids have emerged as important candidates for the management of various cancers including CRC. Naringin is one of the key citrus flavonoids. It is abundantly present in various citrus fruits and some vegetables. This

flavonoid is well known for its numerous biological and therapeutic properties. Recent reports have supported its protective role against CRC. The anti-inflammatory and anti-oxidant potential along with anti-proliferative activity of this flavonoid seems promising and may be useful in near future against CRC after more extensive research. Though, limited reports are available revealing the protective effect of naringin against CRC but, still the already executed research has proven the potent candidature of naringin in the management of CRC. The naringin requires detailed investigations on various aspects including mechanism of action, clinical trials, combination based treatments, alternative treatment based strategies and other related aspects for its profound future application against CRC.

Declarations

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Conflicts of interests

The authors declare no conflict of interest.

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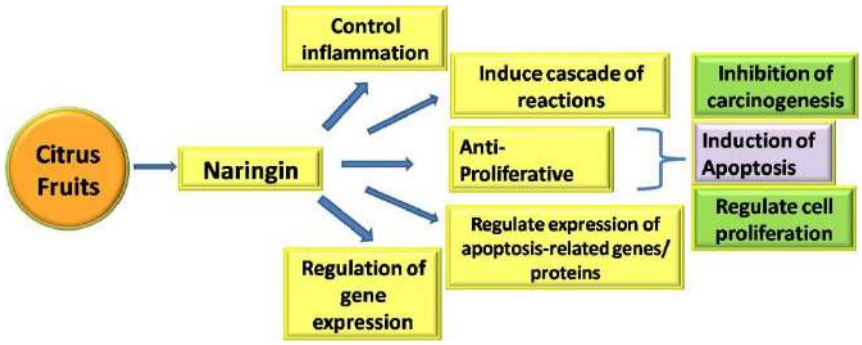

Figure 1: General presentation for effect of naringin against the colorectal cancer cells and related aspects.

RESEARCH ARTICLE

Altitudinal Variations in Secondary Metabolites Content and Antioxidant Activity of Root Extract of *Achyranthes aspera* L.

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ABSTRACT

Secondary metabolites determine the quality of herbal medicine. The effect of altitude on the total phenol, flavonoid, and antioxidant potential of *Achyranthes aspera* L. root collected from three different altitudes in the Garhwal Himalaya was examined in this study. The total phenolic content was determined using the Folin Ciocalteu method spectrophotometrically. The total flavonoid content was determined using aluminium chloride colorimetric test. A 2, 2-diphenyl-1picrylhydrazyl (DPPH) assay was used to determine antioxidant activity. A significant increase ($p<0.05$) was observed in total phenol content, flavonoid content, and antioxidant potential with increasing altitude in chloroform, methanol, and distilled water extract. In comparison to chloroform and distilled water extracts obtained at high altitudes, methanolic extract of root was shown to have significant phenol, flavonoid content, and antioxidant activity. The findings indicate that higher altitudes plants exposed to the harsh impact of climate have a high quantity of secondary metabolites, which increase their stress tolerance and so strengthen their therapeutic potential.

Keywords: *Achyranthes aspera* L., root extract, total phenolic content, total flavonoid content, antioxidant activity.

INTRODUCTION

Medicinal plants are rich in biodynamic components that can be utilized in medicine development [1]. The phytochemical ingredients extracted from medicinal plants' crude extracts are attributed to their therapeutic properties. These phytochemicals, also known as secondary metabolites, are found in the leaves, flowers, and roots of medicinal plants [2]. Secondary metabolites generated from medicinal plants, such as flavonoids, alkaloids, terpenoids, phenols, tannins, and quinones are used to treat a variety of ailments all over the world [1]. Plant-derived bioactive - compounds, especially phenolic compounds, are the most abundant source of antioxidants [1]. The phytoconstituents profile is strongly influenced by a range of environmental conditions for instance season, altitude, and soil nutrition. Altitude is abiotic stress, and a wide range of environmental parameters, such as mean temperature, precipitation, soil properties, and atmospheric pressure, alter with altitude [2]. *Achyranthes aspera* L. belongs to the family Amaranthaceae. It grows as a weed throughout tropical Asia, Africa, Australia, and North America [3]. It is widely disseminated throughout India. Cough, fever, diarrhoea, asthma, boils, hypertension, skin eruptions, pneumonia, snake bite, gonorrhea, kidney stone, and diabetes are all reported to be treated with it [4]. It has antibacterial, antifungal, antiparasitic, anti-helminthic, and anti-hepatic properties [4, 5]. The preliminary phytochemical screening of *Achyranthes aspera* L. root activity has been reported earlier [6]. However, the altitudinal variation of secondary metabolites of *Achyranthes aspera* L. has not been thoroughly investigated. As a result, the current study was carried out to investigate variations in total phenolic, flavonoid content, and antioxidant potential of *Achyranthes aspera* L. root collected from various altitudes in Garhwal Himalaya.

MATERIALS AND METHODS

Chemicals and reagents

Glucose, Gallic acid, Aluminium chloride, Sodium hydroxide, Rutin, Sodium nitrite, Folin Ciocalteau reagent, Sodium carbonate, Ascorbic acid, DPPH, and other reagents were laboratory-grade, purchased from Hi-Media. The plant extracts were prepared by using laboratory-grade solvent methanol, chloroform, and aqueous extract.

Sample collection

Three sites namely, Haridwar (<500 m AMSL), Srinagar (500 – 1000 m AMSL), and Tehri (>1000 m AMSL) of Garhwal Himalaya were selected for the collection of *Achyranthes aspera* L. The roots of the collected plant were washed with double distilled water to remove dust, then dried in the open air under shade, and powdered with a mixer grinder. The dried root powder was kept at 4°C in airtight polybags.

Extract preparation

Different extracts were prepared by extracting non-polar to polar solvents in a stepwise manner (chloroform, methanol, and distilled water). 50g of the powdered root was extracted with chloroform using the Soxhlet apparatus, followed by methanol and distilled water. Whatman no.1 filter paper was used to filter the plant extract. These extracts were concentrated and dried at 40ºC in a vacuum rotary evaporator [4].

Extraction yield

The percentage of extraction yield was calculated [4] as follows:

$$Extraction\ yield = \frac{W_e}{W_s} X100$$

where, We = Extract's weight after evaporation of the solvent, Ws = Weight of the dry sample

Qualitative phytochemical screening

The standard methods following [7 – 15] were incorporated for qualitative phytochemical screening of metabolites from chloroform, methanol, and distilled water root extracts.

Quantitative estimation

Estimation of total phenolic content

The Folin-Ciocalteu technique published by Makkar [16] with slight modification was used to measure the total phenolic content of the extract. The absorbance was measured at 725 nm using a Systronics double beam UV-Vis spectrophotometer (Model AU-2701). Gallic acid was used as standard. The total phenolic content was expressed as milligrams of gallic acid equivalents per gram dry weight of extract (mg GAE/g DW). The equation of the standard curve was y = 0.0197x + 0.0289, R^2= 0.9976.

Estimation of total flavonoid content

The aluminium chloride method reported by Zhishen et al. [17] with slight modifications was used to determine the total flavonoid concentration of extract. The absorbance was performed at 510 nm using a Systronics double beam UV-Vis spectrophotometer (Model AU-2701). A calibration curve of Rutin was prepared to determine total flavonoid concentration. The concentration of total flavonoid content was expressed as mg rutin equivalents per gram dry weight of each extract (mg RE/g DW). The equation of the calibration curve was y = 0.0021x-0.0019, R^2 = 0.9957.

Antioxidant activity

DPPH assay

The antioxidant activity of the root of different extracts was determined using the DPPH-free radical scavenging assay described by Abi Beaulah and Truong et al. [18 – 19]**.** Absorbance was measured at 517 nm. Ascorbic acid was used as a standard. The percent DPPH scavenging effect was calculated using the following equation:

$$\text{DPPH scavenging effect } (\%) = \frac{(\text{A0} - \text{A})}{\text{A0}} \text{ X100}$$

Where A0 = Absorbance of negative control, A1 = Absorbance of standard or sample.

The value of IC_{50} (inhibitory concentration), was calculated by plotting the percentage of residual DPPH against the sample concentration.

Statistical analysis

All the tests were performed in triplicates and the result was expressed as mean ± SD. The results were compared by one-way ANOVA followed by Tukey's test, and p values < 0.05 were considered significant.

RESULTS AND DISCUSSION

The growing need for therapeutically effective secondary metabolites can be reliably met if we can map the fluctuation in secondary metabolite content in plants attributed to changes in altitudes and seasons. As a result, assessing altitudinal variation in plant secondary metabolites, which is induced by environmental conditions that vary with the altitude of the growing site, is critical [1]. In the present study, at all three altitudes, the highest extraction value was obtained in distilled water (Table 1), followed by methanol and chloroform, indicating that highly polar solvents promote high extraction yield [19] (Fig. 1). Carbohydrates, protein, amino acid, phenol, flavonoid, saponin, glycosides, and terpenes were found in *A. aspera* L. root extract at all three elevations. However, steroids were present in Haridwar and Srinagar samples. Subsequently, gums and mucilage were detected in Srinagar sample (Table 2). The results of quantitative analysis of the total phenolic content of chloroform, methanol, and distilled water extracts of *A. aspera* L. root in all the three sites of Garhwal Himalaya are presented in (Table 3 and Fig. 2).

For chloroform, and methanol extract, the maximum phenolic content was noted in Tehri while the minimum was in Haridwar. For distilled water extract the highest phenolic content was found in Tehri and the lowest content was found in Srinagar (Table 3). Nonetheless, the variations in phenolic content in different plants with changing altitude have been studied by many workers [1, 20 – 24]. Their findings are in accordance with the present study showing an increase in total phenolic content with the increasing altitude. For quantitative analysis of the total flavonoid content

of chloroform, methanol, and distilled water extracts, the highest flavonoid content was observed in Tehri and the lowest in Haridwar (Table 4, Fig. 3). The present work is in consonance with the study presented by several researchers [2, 25 – 31]. The antioxidant activity of different extracts was illustrated in (Table 5, Fig. 4). The Ascorbic acid was used as a standard with IC_{50} value was calculated to be 15.05 ± 0.60 µg/mL. The IC_{50} value of all the extracts was higher than ascorbic acid. The lowest IC_{50} value was found in Tehri for chloroform, methanol, and distilled water extracts. Likewise, a higher antioxidant activity with a low IC_{50} value has also been reported earlier by some workers [32 – 33]. The changes in antioxidant activity with altitude were revealed in various studies [23 – 31] which validates the findings of the current study. Altitude plays an important role in the formation of secondary metabolites, which alter free radical scavenging ability [23]. As the elevation rises, plants are exposed to more UV radiation, which expedites the generation of damaging free radicals [23]. The high content of secondary metabolites and escalated antioxidant activity at Tehri (highest altitude) could be attributed to plants' increased production of UV-absorbing and antioxidant phenolics in response to decreased temperature and increased UV-B radiation [34]. Many researchers proposed that plants at higher altitudes are exposed to higher UV-B radiations, which have pleiotropic effects on morphology, plant development, and physiology [35]. For this reason, the biosynthesis of flavonoids and phenols is the most effective protection mechanism stimulated under the light regime. This helps to explain why higher altitude *A. aspera* L. root extract has more phenol and flavonoid content than that of lower altitude [35].

CONCLUSION

In our study, it was observed that as the altitude increases the content of secondary metabolites and antioxidant potential of the root of *Achyranthes aspera* L. increases. Among the three solvents, methanol was the best solvent for the estimation of total phenolics and flavonoids content. Furthermore, analysis of variance supports our findings that the altitudinal gradient is a key factor in detecting significant results in the root of *Achyranthes aspera* L.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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Table 1 Determination of extractive value of *Achyranthes aspera* L. root in different solvents from different altitudes of Garhwal Himalaya

Locations	Altitudes(m)	Root extract (%)		
		Chloroform	Methanol	Distilled water
Haridwar	Below 500	0.88	4.51	9.12
Srinagar	500 – 1000	0.48	10.31	12.38
Tehri	Above 1000	0.96	9.78	11.76

Table 2 Result of phytochemical screening of *Achyranthes aspera* L. root in different solvents from different altitudes of Garhwal Himalaya

S. No.	Phytochemicals	Tests	C. E			M. E			D. E		
			H	S	T	H	S	T	H	S	T
1.	Carbohydrates	Benedicts test	-	+	-	+	+	+	-	+	+
		Molish's test	+	+	+	+	+	-	-	+	-
		Fehling's test	-	-	-	+	+	+	-	-	+
2.	Proteins	Biuret test	-	-	-	-	-	-	-	-	-
		Xanthoprotenic test	+	+	+	+	+	-	+	+	+
3.	Amino-acids	Ninhydrin test	-	-	-	+	+	+	-	-	-
4.	Alkaloids	Wagner's	-	-	-	-	-	-	-	-	-
		Mayer's	-	-	-	-	-	-	-	-	-
		Dragendroff's test	-	-	-	-	-	-	-	-	-
5.	Phenols	Lead acetate test	+	+	+	+	+	+	+	+	+
6.	Tannins	Ferric chloride test	-	-	-	-	-	-	-	+	-
		Gelatin test	-	-	-	-	-	-	-	-	-
7.	Flavonoids	Lead acetate test	-	+	+	+	+	+	+	+	+

8.	Saponins	Honeycomb	-	-	-	+	-	-	+	+	+
		Foam test	-	-	-	+	-	-	+	-	+
9.	Steroids	Salkowski's test	-	+	-	+	-	-	-	+	-
10.	Terpenes		-	+	-	+	+	+	+	-	-
11.	Glycosides	Keller-Killiani test	+	+	+	+	+	+	-	+	-
		Glycosides test	+	-	-	+	-	-	-	-	-
12.	Gums and mucilage		-	-	-	-	-	-	-	+	-
13.	Fixed oil and fats		-	-	-	-	-	-	-	-	-
14.	Volatile oils		-	-	-	-	-	-	-	-	-

C.E = chloroform extract, M.E Methanol extract, D.E Distilled water extract, + = presence, - = absence
H= Haridwar, S= Srinagar, T= Tehri.

Table 3 Total phenolic content of different extracts of the root of *Achyranthes aspera* L. from different altitudes of Garhwal Himalaya

Locations	Altitudes(m)	Total phenolic content (mg GAE /g DW)		
		Chloroform	Methanol	Distilled water
Haridwar	Below 500	1.22 ± 0.1	1.85 ± 0.4	1.53 ± 0.1
Srinagar	500 – 1000	1.85 ± 0.1	3.83 ± 0.2	1.26 ± 0.2
Tehri	Above 1000	4.00 ± 0.3	4.23 ± 0.1	2.42 ± 0.3

All values are the mean ± SD(n=3)

Table 4 Total flavonoid content of different extracts of the root of *Achyranthes aspera* L. from different altitudes of Garhwal Himalaya

Locations	Altitudes(m)	Total Flavonoid content (mg RE /g DW)		
		Chloroform	Methanol	Distilled water
Haridwar	Below 500	9.98 ± 1.0	17.83 ± 1.7	10.94 ± 1.0
Srinagar	500 – 1000	40.89 ± 1.9	62.84 ± 1.2	44.74 ± 1.0
Tehri	Above 1000	54.51 ± 2.3	80.46 ± 0.7	60.27 ± 1.2

All values are the mean ± SD(n=3)

Table 5 The 50% inhibitory concentration (IC_{50}) values of DPPH scavenging activity of different *Achyranthes aspera* L. root extract from different altitudes of Garhwal Himalaya

Locations	Altitudes(m)	IC_{50} value μg/mL		
		Chloroform	Methanol	Distilled water
Haridwar	Below 500	425.93 ± 0.5	283.63 ± 6.3	410.14 ± 7.1
Srinagar	500 – 1000	282.96 ± 5.6	280.25 ± 6.8	392.52 ± 4.0
Tehri	Above 1000	259.87 ± 3.9	128.83 ± 3.0	356.48 ± 1.3

All values are the mean ± SD(n=3)

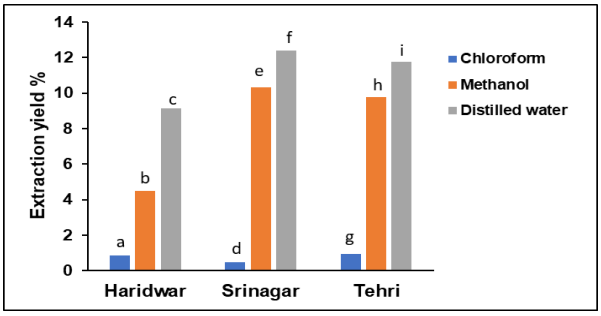

Figure 1 Changes in extraction yield obtained from different solvents. Data marked with the different letters are significantly different ($p < 0.05$) from each other. Experiments were conducted in triplicates (Mean ± SD).

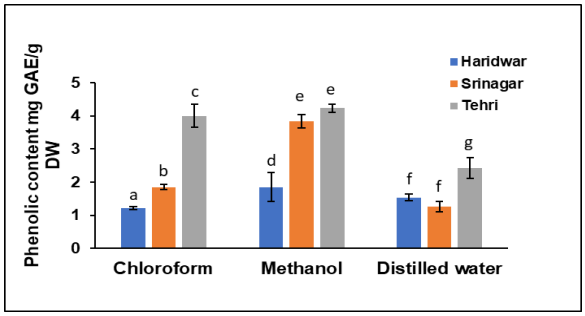

Figure 2 Altitudinal variations in phenolic content of *A. aspera* L. root extract in chloroform, methanol, and distilled water. Data marked with the same letters are not significantly different ($p < 0.05$) from each other. Experiments were conducted in triplicates (Mean ± SD).

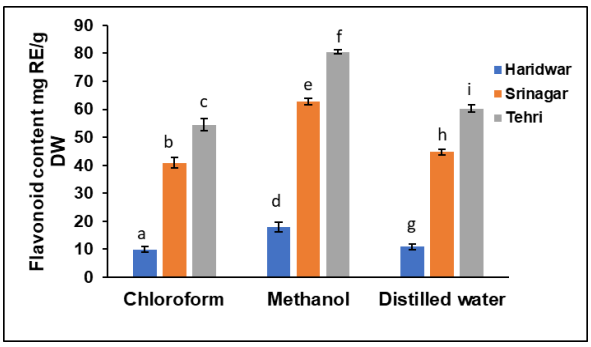

Figure 3 Altitudinal variations in flavonoid content of *A. aspera* L. root extract in chloroform, methanol, and distilled water. Data marked with the different letters are significantly different ($p < 0.05$) from each other. Experiments were conducted in triplicates (Mean ± SD).

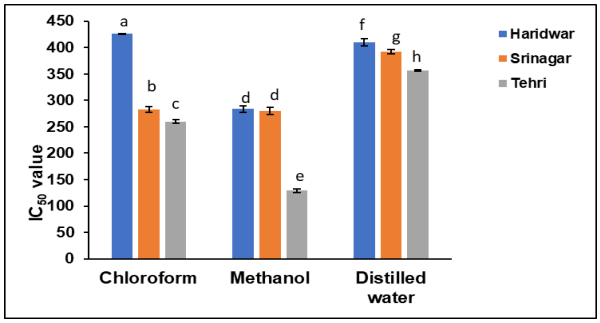

Figure 4 :Altitudinal variations in IC_{50} value of *A. aspera* L. root extract in chloroform, methanol, and distilled water. Data marked with the same letters are not significantly different ($p < 0.05$) from each other. Experiments were conducted in triplicates (Mean ± SD).

RESEARCH ARTICLE

Phytochemical Screening, GC-MS Analysis and *In- vitro* Cytotoxicity Assay in the Ethanolic Extract of *Nigella sativa* seeds against HeLa and A549 Cancer Cell Line

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ABSTRACT

Medicinal plants that possess the natural active compounds for many diseases in current scenario. The use of naturally acquired agents to cure cancer is on the rise. *Nigella sativa* seeds are important natural remedy for many ailments and diseases. They are used in ancient time for many diseases instead of chemical drug. This review focuses on the thymoquinone is the versatile compounds which is mostly present in the seeds of phytochemical screening is done to identify the secondary metabolites and result revealed various compounds has been identified in the seed extract using GC-MS and anti-cancerous agents found in the ethanolic extract of the seed. Anti-proliferative assay (MTT ASSAY) was done in two cell lines such as HeLa and A549 were found explicit anti-cancerous agent as it inhibited cell proliferation in these cancer cell-lines. This review emphasizes *Nigella sativa* seed extract as therapeutic potential against cancer and hence proved that it can be used alone or in combination with chemotherapeutic drugs in future.

Keywords: *Nigella sativa,* Thymoquinone, GC-MS, HeLa cell line, A549 cell line .

INTRODUCTION

Natural traditional drug uses plant-based properties as a good remedy for various treatment. Research to develop antitumor drug from herbal plants began from 1950s[1].Alkaloids, sterol, flavonoids, terpenoids, tannins were found in very small quantities in the plant are the secondary metabolites[2]. The extraction of the active principle

involves the diffusion of the compounds from natural plant and solubilize in the suitable solvent system with similar polarity and used for the extraction[3]. Different kind of allopathy drug is commercially available in global market for emergency in various diseases such as Cancer, Cardiovascular disease , Liver disease, Diabetes Melitus and infectious diseases etc. It was used for immediate recovery in recent days but it leads to side effects and adverse effect to our body. World Health Organization estimated that more than 75% of people worldwide rely on natural herbal drugs for primary health related problems Some factors that contribute to the onset of the cancer disease include Infections (15-20%), Tobaco consumption (25-30%), Diet and Obesity (30-35%),Radiation (10%.)Stress and environment pollutions, lack of physical activity[4].

The treatment of chemotherapy using synthetic drugs can produce severe harmful side effects and hence its usage has been restricted [5]. Vincristine and Vinblastine were the first herbal plant-based drugs used clinically for the treatment of tumor . These compounds are primarily used in combination with other cancer chemotherapeutic drugs for the treatment for a variety of cancers, including lung, breast cancer , lymphomas, and leukemia [6].The current research reports that the inhibiting and delaying the tumor growth carried out by the active principle derived from natural medicinal plants [7].The essential advantages of plant-based drugs are their safety efficacy and affordability [8]. Nigella sativa is an annual flowering plant belongs to the family *Ranunculaceae* which is mainly applied for different kind of diseases. Thymoquinone found in the plant drug has been reported that in various of therapeutic effects in various diseases. It has been proved that NS is an excellent antioxidant and anti-cancer activity by *in vitro* and in-vivo methods .

MATERIALS AND METHODS

Preparation of plant extract

Collected seed part of *Nigella sativa* procured from local market and seed part of the plants were prepared for different solvent extractions such as ethanol, chloroform, petroleum ether and water .

Preparation of plant extract

About 25 gm of plant material was dissolved in 250 ml of ethanol, chloroform, petroleum ether and aqueous and kept it in a shaker for 24 hours. The extract was filtered through Whatmann No 1 filter paper and residue was collected. The filter was concentrated using a rotator vacuum evaporator to get ethanol extract of the dried plant powder. Each time before extracting with the next solvent the residue was air dried thoroughly to remove the traces of solvent used.

Soxhlet Extraction

Soxhlet extraction process is mainly required where the desired compound has a limited solubility in a solvent, and the impurity is insoluble in that solvent. If the desired compound has a high solubility in a solvent then a simple filtration can be used to separate the compound from the insoluble substance [9].

Phytochemical analysis

The preliminary qualitative phytochemical studies were performed for analyzing the secondary metabolites present in the different extracts. The Phytochemical Screening of the extracts was conducted using procedure described scribed by Trease and Evans [10]

Detection of Alkaloids

Mayer's Test: Filtrates were treated with few ml of Mayer's reagent (Potassium Mercuric lodide)
Wagner's Test: Filtrates were treated with few ml of Wagner's reagent (lodinein Potassium Iodide).

Detection of Flavonoids

Plant Extracts were treated with few ml of NaOH solution.

Detection of Phenols
Plant extracts mixed with few ml of Ferric Chloride

Detection of Saponins
Foam Test:0.5 gm of extract was shaken with2ml of foaming reagent persists for ten minutes it indicates the presence of saponins.

Detection of Tannins
3-5 ml test solution with few drops of 1 ml Lead acetate and observed red precipitate was observed and indicates the presence of tannin.

Detection of Steroids
3ml of test solution and minimum quality of chloroform was added with 1-4 drops of acetic anhydride and one drop of concentrated Nitric acid .

Detection of Proteins
Xanthoproteic Test**:** Plant extracts were treated with few drops of con Nitric acid .

Detection of Diterpenes
Copper acetate Test**:** Extracts were dissolved in water and trail willy 3-4 drops of copper acetate solution.

Gas Chromatography/Mass Spectrometry (GC/MS)
GC/MS analysis is a common confirmation technique and used to make an effective chemical analysis. The first step of GC/MS was started by injecting the sample to the cod pord of the gas chromatography (GC) device. A mixture compounds will separate into simple substances when heated. Heated gas compounds were carried through a column with an inert gas . The test drug was evaporated in the junction part of the GC technique and segregated in the column by adsorption and desorption technique with suitable temperature which is controlled by software tools . Separation of the eluted components depends on the boiling point of the individual components.[11,12,13].

MTT Assay
This is colorimetric assay is depends on the reduction of a yellow tetrazolium salt (3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide or MTT) to purple formazan crystals by metabolically active cells. Rapid colorimetric method dependson the breakdown of the tetrazolium ring of MTT (3-(4,5-dimethylthazolk-2-yl)-2,5-diphenyl tetrazolium bromide) by mitochondrial enzyme assay. Procedures were repeated at thrice. The average was calculated and compared with the control and test samples. The percentage of cytotoxicity was calculated using standard formula.[14]

RESULTS AND DISCUSSION

Phytochemical screening
Aqueous, Ethanol, Chloroform ,and Petroleum ether extracts of the seed part of *Nigella sativa* showed the presence of compounds such as Alkaloids, Flavonoids, Phenols, Tannins, Phytosterols, Proteins Hence, the phytochemical screening of the ethanolic extraction reported that the higher amount of secondary metabolites when compared to other solvents.

GC-MS analysis of active compounds from ethanolic extract of *Nigella sativa* seed
The peaks are marked with retention time in the GC-MS chromatogram of the ethanol extract showed that *Nigella sativa* seeds are rich in secondary metabolites. We found that many active compounds were found in the *Nigella sativa* extract, Cyclohexene 3,3,5 trimethyl is identified in a higher quantity. Thymoquinone is present in the sample

in 0.475 which is the most prominent constituent of *N. sativa* seeds . The recent research reported that the same active group compounds such as mono terpenoid phenol – Thymol found in volatile ethanolic extraction of the seed part of *Apium leptophyllum* (Pers) belongs to Apiaceae family possessed highest peak area was 96.36%.through GC-MS Analysis technique [15]. GC- MS result showed that the presence of several active compounds found in EENS it may be better anticancer activity for various cancer cell line .

MTT Assay

Cell line : A549- Lung Cancer cell line & HeLa cell line- Cervical Cancer cell line

This results concludes that *Nigella sativa* seed extract is an excellent anti-cancer activity against A549 and HeLa cell lines. Thymoquinone an organic compound found in the seed extract is identified using GC-MS and it has proved that better therapeutic agents against various cancer cell lines from the review of literature studies. The rate of the percentage of cytotoxicity increased and cancer cell viability level decreased in a maximum concentration of EENS in 100µg. The increased cytotoxicity 82 % in a maximum concentration (100µg) of EENS in A549- Lung Cancer cell line and 73 % of cancer cell cytotoxicity in maximum concentration(100 µg) of EENS in HeLa cell line The cytotoxicity studies concluded that the ethanolic extract of *N.Sativa* has better cytotoxicity against A549- Lung Cancer cell line when compared to HeLa cell line.

SUMMARY AND CONCLUSION

N. sativa seed extracts and some of its active principles, possess remarkable in vitro cytotoxicity against the different type of cancers such as A549 and HeLa cell lines. Appropriate modifications in the molecular structure of thymoquinone and could lead to more effective and safer drugs for the treatment of tumors. Moreover, *N. sativa* seed, its oil, thymoquinone, or their analogs could be used in suitable combinations with established as chemotherapeutic agents. This results revealed that Nigella sativa seed extract is an significant anti-cancer activity against A549 and HeLa cell lines. Thymoquinone and other essential active compounds were identified by using GC-MS and it has proved that it may be a unique and better therapeutic agents against various cancer cell lines . The rate of the percentage of cytotoxicity increased and cancer cell viability level decreased in a maximum concentration of EENS in 100µg. The cytotoxicity studies concluded that the ethanolic extract of *N.Sativa* has better cytotoxicity against A549- Lung Cancer cell line when compared to HeLa cell line. We can recommend the plant drug for various type of cancer disease alternative to chemotherapy and radiation therapy. They have leads to a lot of side effects and adverse effect to our body during treatments. Natural therapy does not leads to any side effect to the normal cells during the treatment of cancer because it has completely derived from natural medicinal plants. Finally, it is hoped that this review would be a source of encouragement and guidance for the interested investigators to conduct further preclinical and clinical studies on the use of N. sativa for the treatment of cancer

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Table -1:Phytochemical Screening

BIOACTIVE COMPOUNDS	ETHANOL	PETROLEUM ETHER	CHLOROFORM	WATER
ALKALOIDS	+	+	-	-
FLAVANOIDS	++	-	-	+
PHENOL	++	-	+	-
TANNINS	+	-	-	-
STEROL	++	+	+	-
SAPONIN	-	+	-	-
PROTEINS	+	+	+	-
DITERPENES	+	-	+	+

Table -2 GC-MS Analysis of Active Compounds From Ethanolic Extract of *Nigella sativa* Seeds

SL NO	RT (MIN)	NAME OF THE COMPOUND	MOLECULAR FORMULA	MW g/mol	PEAK%
1	29.6989	Cyclohexene 3,3,5trimethyl	C9H16	124.22 g/mol	1.475
2	23.1062	Ethan one 1-(4-hydroxyphenyl)-2-phenyl	C14H12O2	151.16g/mol	0.9
3	27.6372	Hexadecanonicacid, ethyl ester	C18H36O2	300.5 g/mol	0.775
4	15.1649	Thymoquinone	C10H12O2	164.20108 g/mol	0.475
5	34.7243	1,3,7,7 tetrameth-2,11-dioxabicyclo(4.4.1)undeca-3,5,9-trien-8one	C13H16O3	220.26 g/mol	0.5
6	31.4020	11,14-eicosadienoic acid	C20H36O2	308.5g/mol	0.375
7	32.9365	Hexadecanoic acid,2-hydroxy-1 (hydroxymethyl)ethyl ester	C19H38O4	330.5 g/mol	0.175

8	28.9258	5-isotrotenyl-2-methyl-7-oxabicyclo(4.1.0)heptan-2-ol	C10H16O2	168.23 g/mol	0.25

Table 3. MTT ASSAY: CELL LINE: A549- Lung Cancer cell line

(µg)Concentration (µg)	00005-1 Liquid: Seed Extract		
	% of Cytotoxicity	Cell viability	Reactivity
5	67	33	Moderate
25	72	28	Severe
50	76	24	Severe
75	78	22	Severe
100	82	18	Severe

Table -4: Cell Line: HeLa Cell line - Cervical cancer cell line

(µg)Concentration (µg)	00005-1 Liquid: Seed Extract		
	% of Cytotoxicity	Cell viability	Reactivity
5	47	53	Mild
25	59	41	Moderate
50	60	40	Moderate
75	62	38	Moderate
100	73	27	Severe

Fig -1 :The ethanolic extract of *Nigella sativa* seed extract showed moderate to severe cytotoxicity to A-549 cells after 24hrs in a maximum concentration of 100µg

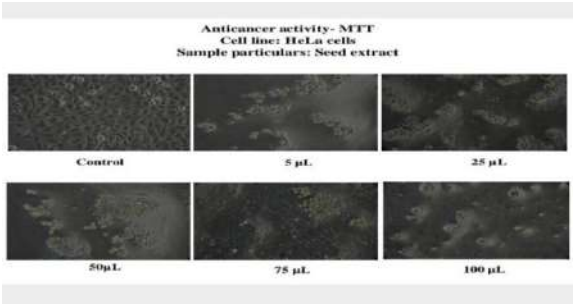
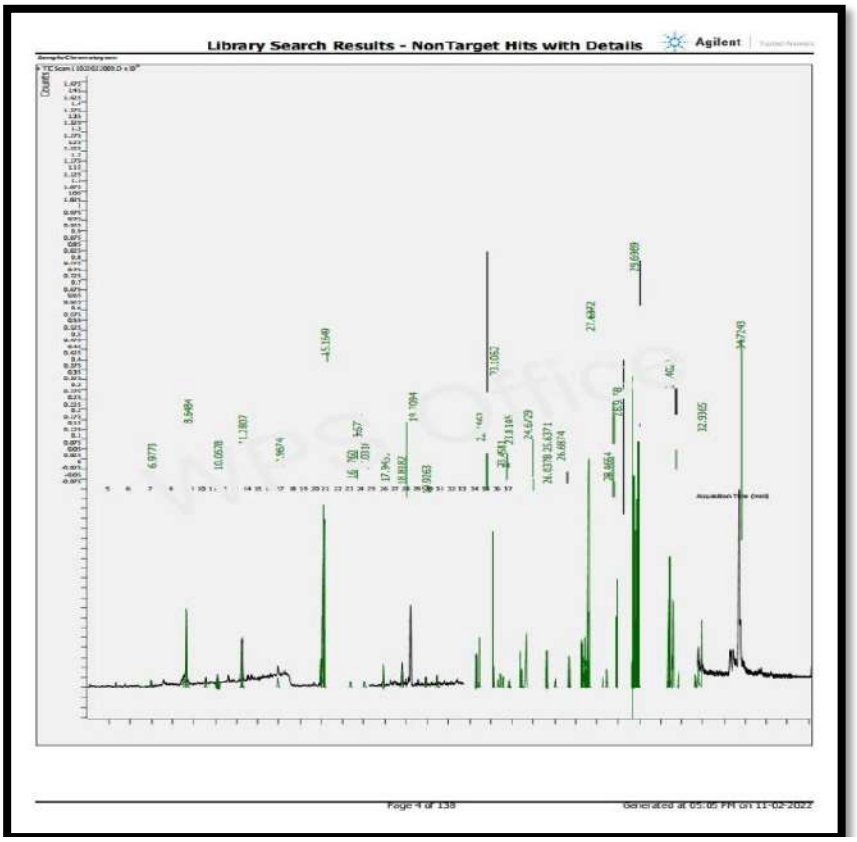


Fig -2 :The ethanolic extract of *Nigella sativa* showed mild to severe cytotoxicity to HeLa cells after 24hrs in a maximum concentration of 100µg



Graph -1 : Library Search Results – Non target Hits with Details

RESEARCH ARTICLE

Agronomic Approaches to Enhance the Nutrient Uptake and Seed Yield in Irrigated Redgram (C*ajanus cajan* L.)

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ABSTRACT

Field experiment was conducted to improve the productivity of redgram through different nutrient management practices at Farmer's Field, Palacode, Palacode Taluk, Dharmapuri District. The experiments were laid out in randomized block design (RBD) with three replications comprising of 9 treatments *viz*., T_1 - control, T_2 - 100% Recommended Dose of Fertilizer (RDF), T_3 - 125% Recommended Dose of Fertilizer (RDF), T_4 - 100% Recommended Dose of Fertilizer + Nipping, T_5 - 125% Recommended Dose of Fertilizer + Nipping, T_6 - 100% Recommended Dose of Fertilizer + Micronutrient, T_7 - 125% Recommended Dose of Fertilizer + Micronutrient, T_8 -100% Recommended Dose of Fertilizer + Nipping + Micronutrient and T_9 - 125% Recommended Dose of Fertilizer + Nipping + Micronutrient. The results of the field experiment on the rice revealed that application of 125% Recommended Dose of Fertilizer + Nipping + Micronutrient showed a significant increment in the yield attributes, yield and nutrient uptake.

Keywords: Pigeonpea, nipping, macro and micronutrients

INTRODUCTION

Redgram is the fifth prominent grain legume in the world and second in India after chickpea (Narendra *et al*., 2013). It is avital multi-purpose pulse legume crop in the tropics and subtropics, endowed with several unique characteristics. Redgram is used in more diversified ways than other pulses. Pulses are the major sources of protein among the vegetarians in India and complement the staple cereals in the diet with proteins, essential aminoacids,

vitamins and minerals. It contains 22-24% protein, which compares well with that of other important grain legumes which is almost twice the protein in wheat and thrice that of rice. Redgram is commonly known in India as pigeonpea or arhar or tur. In India, pigeonpea is grown in area of 3.88 million hectares with the production of 2.80 million tonnes with the productivity of733.4 kg ha^{-1}. The productivity of redgram is low due to cultivation on agriculturally marginal and sub marginal lands under poor management. So, it needs earnest attention in adoption of desirable production technologies to exploit the yield potential of the redgram and it can be possible by application of fertilizers, nipping and foliar application of nutrients. Low and imbalanced use of fertilizer is one of the major reasons for low productivity. Optimum nitrogen and phosphorus nutrition result in development of deep root system, increased leaf area and chlorophyll content. Foliar application is credited with the advantage of quick and efficient utilization of nutrients, eliminating losses through leaching and fixation and helps in regulating the uptake of nutrients by plants. Foliar nutrition is recognized as an important method because it facilitates easy and rapid utilization of nutrients(Thakur *et al*., 2017). In general, when the vertical growth of the plant is arrested or restricted the growth of lateral branches gets induced. With this concept in view, the terminal buds are usually removed in crops like cotton and castor to induce more auxiliary branches. Similarly, in redgram also nipping of terminal bud significantly increased the number of branches and pods $plant^{-1}$ (Sujatha *et al.,* 2016,Sonboir *et al.,* 2017 and Sonendra Kumar *et al.,*2018).

MATERIALS AND METHODS

Field experiment was at Farmer's Field, Palacode, Palacode Taluk, Dharmapuri District to study the effect of nipping and nutrients on nutrient uptake and seed yield in irrigated redgram. The experimental site is situated at 12º30′ N latitude and 78º07′ E longitude at an altitude of 533 meters above mean sea level. The weather of Palacode is moderately warm with hot summer months. The mean maximum temperature fluctuates between 30.65 and 36.12°C with a mean of 33.38°C while the minimum temperature ranges from 22.1 to 24.53°C with a mean of 23.3°C. The mean relative humidity is 69.75 per cent. The mean annual rainfall is 877 mm. The soil of the farmer's field was clay loam in texture with PH of 7.7. The soil was low in available nitrogen, medium in available phosphorus and high in available potassium. The experiments were laid out in randomized block design (RBD) with three replications comprising of 9 treatments *viz.,* T_1 - control, T_2 - 100% Recommended Dose of Fertilizer (RDF), T_3 - 125% Recommended Dose of Fertilizer (RDF), T_4 - 100% Recommended Dose of Fertilizer + Nipping, T_5 - 125% Recommended Dose of Fertilizer + Nipping, T_6 - 100% Recommended Dose of Fertilizer + Micronutrient, T_7 - 125% Recommended Dose of Fertilizer + Micronutrient, T_8 -100% Recommended Dose of Fertilizer + Nipping + Micronutrient and T_9 - 125% Recommended Dose of Fertilizer + Nipping + Micronutrient. A manurial schedule of 25: 50: 25 kg of N, P_2O_5 and K_2O per hectare was followed. Entire dose of N, P_2O_5 and K_2O were applied basally. The nitrogen, phosphorus and potassium were supplied through urea (46% N), single super phosphate (16% P_2O_5) and muriate of potash (60% K_2O). Fertilizer dose increased as per the treatment schedule. The foliar spraying of 0.5 per cent Micronutrient mixture was done as per treatment schedule on 30th & 45th DAS using Knapsack Sprayer. The spray fluid used per hectare was 500 lit. ha^{-1}.

RESULTS AND DISCUSSION

Yield attributes and yield

Yield attributes and yield significantly influenced by the nutrient management practices and nipping in irrigated redgram(Table 1). The maximum number of branches $plant^{-1}$ (18.95), pods $plant^{-1}$ (165), seeds pod^{-1} (4.99) and seed yield (1896 kg ha^{-1})were significantly registered with the application of 125%RDF + Nipping + Micronutrient mixture (T9). The better performance of integrated supply of nutrient increased the availability and uptake of nutrients which could have favoured better translocation of photosynthetic from source to sink. Nipping of terminal bud activated the dormant lateral buds to produce more branches. More over, by nipping the terminal buds, the utilization of photosynthates lead to increased number of branches$plant^{-1}$(Imayavaramban *et al*.,2004). The mineral nutrients are directly involved in the synthesis of protein, chloroplast pigments and electron transfer, thus increasing the nutrient

levels which lead to increased photosynthetic activity of redgram plant which naturally accounts for higher number of primary and secondary branches per plant (Amruta *et al.,*2015). Foliar application of micronutrients might have been easily absorbed by plant system and translocated more effectively and efficiently into developing pods and might have resulted in proper seed filling, which ultimately reflected with higher seed yield. A similar result of finding was in concomitance with Zambre*et al.* (2017). Moreover, nipping of terminal buds might have offered congenial crop architecture that exploit the available resources to the maximum extent and resulted in appreciable improvement on growth, yield parameters and on seed yield. These results are accordance with the findings of Dhital*et al.,* (2017).

Nutrient uptake

In view of the desired crop canopy that was obtained with the practice of nipping along with application of NPK and micronutrients foliar spray necessitated the increased uptake of available nutrients from the soil in redgram(Table 2).Application of nitrogen and micronutrient increased the nutrient uptake which could be attributed to increased availability of nutrients throughout the growing period which in turn influenced the DMP that again paved way for higher nutrient uptake. These results are in conformity with the finding of Verma (2011).

CONCLUSION

The nutrient management practices and nipping registered the maximum values of yield attributes, seed yield and nutrient uptake of redgram. Based on the results of the present study, application of 125% Recommended Dose of Fertilizer + Nipping + Micronutrient mixture foliar spray would likely be an effective approach fo rutilization of nutrients and to enhance redgram yield.

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Table 1: Effect of nutrient management practices and nipping on yield attributes andyield of irrigated redgram

Treatments	number of branches plant^{-1}	number of pods plant^{-1}	Number of seeds pod^{-1}	Seed yield (kg ha^{-1})
T_1- Control	13.02	109	3.89	950
T_2 – 100% Recommended Dose of Fertilizer (RDF)	14.23	121	4.23	1172
T_3 – 125% RDF	15.92	136	4.32	1364
T_4– 100% RDF + Nipping	17.29	150	4.28	1580
T_5– 125% RDF+ Nipping	18.66	163	4.37	1790
T_6– 100% RDF + Micronutrient	14.56	124	4.84	1247
T_7– 125% RDF+ Micronutrient	16.12	138	4.92	1461
T_8– 100% RDF+ Nipping + Micronutrient	17.49	152	4.88	1676
T_9– 125% RDF+ Nipping + Micronutrient	18.95	165	4.99	1896
S.Ed	0.32	2.78	0.08	52.02
CD (P = 0.05)	0.68	5.89	0.19	110.24

Table 2: Effect of nutrient management practices and nipping nutrient uptake of irrigated redgram.

Treatments	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
T_1 - Control	71.47	12.20	60.16
T_2 – 100% Recommended Dose of Fertilizer (RDF)	74.88	13.52	62.63
T_3 – 125% RDF	79.21	15.65	68.26
T_4 – 100% RDF + Nipping	83.03	16.92	72.17
T_5 – 125% RDF + Nipping	98.53	18.79	78.56
T_6 – 100% RDF + Micronutrient	76.47	13.99	64.74
T_7 – 125% RDF+ Micronutrient	80.86	16.2	69.83
T_8 – 100% RDF + Nipping + Micronutrient	84.77	17.43	74.21
T_9 – 125% RDF + Nipping + Micronutrient	100.39	19.23	80.34
S.Ed	0.97	0.32	1.05
CD (P = 0.05)	2.06	0.68	2.23

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RESEARCH ARTICLE

Branches of SIm.F's in LPWA's

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ABSTRACT

The goal of this paper is to introduce and learn about the concept of strong and SFIm.F of LPWA. Further, we talk about some of their related properties in strong, Normal strong and Cartesian product of FIm.F of LPWA.

Keywords: Implicative filter**(**Im.F**),** Fuzzy Implicative filter**(**FIm.F**),** Strong Implicative filter (SIm.F); Strong Fuzzy implicative filter (SFIm.F); Normal Strong Fuzzy implicative filter(NSFIm.F).

Mathematical Subject classification: 06F35, 30G10

1. INTRODUCTION

Wajsberg algebras are generalised to form pseudo-Wajsberg algebras. Rodica Ceterchi [1] assisted in the addition of pseudo-Wajsberg algebras. Wajsberg algebras were introduced by Mordchaj Wajsbreg. Wajsberg algebra's lattice structure was described. They also introduced the concept of a lattice Wajsberg algebra implicative filter and analysed some of its features. We present the notion of SIm.Fs in LPWA and examine some of its features with demonstrations in this work. We also look on fuzzification of SIm.F and NSFIm.F of LPWA.

2. SIm.F of LPWA

All of the fundamental definitions use the references [1, 2, 3], [4, 5], and [8].

Definition 2.1.1. A SIm.F of $\mathbb{A}$ is a non-empty subset of LPWA $\mathbb{A}$ that satisfies the following axioms for all $\ell, m, n \in \mathbb{A}$.

(i) $1 \in \mathbb{F}$
(ii) $\ell \in \mathbb{F}$ and $\ell \mapsto ((m \mapsto n) \hookrightarrow m) \in \mathbb{F}$ imply $m \in \mathbb{F}$
(iii) $\ell \in \mathbb{F}$ and $\ell \hookrightarrow ((m \hookrightarrow n) \mapsto m) \in \mathbb{F}$ imply $m \in \mathbb{F}$.

Example 2.1.2. Consider a set $\mathbb{A} = \{0, \mathfrak{p}, \mathfrak{q}, \mathfrak{r}, 1\}$. Define a partial ordering "$\leq$" on $\mathbb{A}$, such that $0 \leq \mathfrak{p} \leq \mathfrak{q} \leq 1$, $\mathfrak{r} \leq 1$ and the binary operations " $\mapsto$ "," $\hookrightarrow$ " and the quasi complements " $^-$", " $\tilde{}$ " .(Refer table[4]). The table[4] shows that, $\mathbb{F}_1 = \{\mathfrak{p}, \mathfrak{q}, \mathfrak{r}, 1\}$ is a NIm.F of $\mathbb{A}$. But $\mathbb{F}_2 = \{0,1, \mathfrak{p}, \mathfrak{q}\}$ is not a NIm.F of $\mathbb{A}$. Since, $(\mathfrak{q} \mapsto \mathfrak{p}) = \mathfrak{r} \notin \mathbb{F}_2$ and $(\mathfrak{p} \hookrightarrow \mathfrak{q}) = \mathfrak{r} \notin \mathbb{F}_2$.

Proposition 2.1.3. Let $\mathbb{F}$ be a non-empty subset of $\mathbb{A}$ and $\mathbb{A}$ be a LPWA. Then every SIm.F of $\mathbb{A}$ is an im.F of $\mathbb{A}$.
***Proof*:** Let $\mathbb{F}$ be a SIm.F of $\mathbb{A}$.
Now $\ell \in \mathbb{F}, \ell \mapsto ((m \mapsto n) \hookrightarrow m) \in \mathbb{F}$
Let $\ell = \ell, m = m$ and $n = 1$, then $\ell \mapsto ((m \mapsto 1) \hookrightarrow m) = \ell \mapsto (1 \hookrightarrow m) = \ell \mapsto m$
Thus, $m \in \mathbb{F}$ [From (ii) of the definition 3.1.1]
Similarly, to prove (iii)
Now $\ell \in \mathbb{F}, \ell \hookrightarrow ((m \hookrightarrow n) \mapsto m) \in \mathbb{F}$
Let $\ell = \ell, m = m$ and $n = 1$, then$\ell \hookrightarrow ((m \hookrightarrow n) \mapsto m) = \ell \hookrightarrow (1 \mapsto m) = \ell \hookrightarrow m$
Thus, $m \in \mathbb{F}$ [From (iii) of the definition 3.1.1]
Therefore, $\mathbb{F}$ is an im.F of LPWA.

Proposition 2.1.4. Let $\mathbb{F}$ be a non-empty subset of $\mathbb{A}$ and $\mathbb{A}$ be a LPWA, then the following conditions hold for all $\ell, m, n \in \mathbb{A}$,

(i) $\mathbb{F}$ be a SIm.F
(ii) $(\ell \mapsto m) \hookrightarrow \ell \in \mathbb{F}$ implies $\ell \in \mathbb{F}$
(iii) $\alpha \in \mathbb{F}, (\ell \mapsto m) \hookrightarrow (\alpha \mapsto \ell) \in \mathbb{F}$ implies $\ell \in \mathbb{F}$.

***Proof*: (i)⇒(ii)**
Let $\mathbb{F}$ be a SIm.F of LPWA $\mathbb{A}$ and $(\ell \mapsto m) \hookrightarrow \ell \in \mathbb{F}$ for all $\ell, m \in \mathbb{A}$
Now $1 \mapsto ((\ell \mapsto m) \hookrightarrow \ell) = \ell \in \mathbb{F}$. (By reference[1])
(ii)⇒(iii)
If (ii) holds and let $\alpha \in \mathbb{F}, (\ell \mapsto m) \hookrightarrow (\alpha \mapsto \ell) \in \mathbb{F}$
Consider $\alpha \mapsto ((\ell \mapsto m) \hookrightarrow \ell) = (\ell \mapsto m) \hookrightarrow (\alpha \mapsto \ell) \in \mathbb{F}$ (By reference[1])
Since $\alpha \in \mathbb{F}$ and $\mathbb{F}$ be an im.F of LPWA $\mathbb{A}$.
Therefore, $\ell \in \mathbb{F}$.
(iii)⇒(i)
If (iii) holds and let $\ell, \ell \mapsto ((m \mapsto n) \hookrightarrow m) \in \mathbb{F}$.
Now
$(m \mapsto n) \hookrightarrow (\ell \mapsto m) = \ell \mapsto ((m \mapsto n) \hookrightarrow m) \in \mathbb{F}$ (By reference[1])
Since $\ell \in \mathbb{F}$and from (iii), we have $m \in \mathbb{F}$.
Similarly, we show that $m \in \mathbb{F}$ using another condition.
Therefore, $\mathbb{F}$ be a SIm.F of LPWA $\mathbb{A}$.

2.2 SFIm.F of LPWA
In this part, SFIm.F of LPWA is introduced, and some of its characteristics are explained through examples.

Definition 2.2.1. An SFIm.F is a non-constant FIm.F ζ of LPWA $\mathbb{A}$ that satisfies the axioms given below for all $\ell, m, n \in \mathbb{A}$.

i. $\zeta(1) \geq \zeta(\ell)$
ii. $\zeta(m) \geq \min\{\zeta(\ell), \zeta(\ell \mapsto (m \mapsto n) \hookrightarrow m)\}$
iii. $\zeta(m) \geq \min\{\zeta(\ell), \zeta(\ell \hookrightarrow (m \hookrightarrow n) \mapsto m)\}$.

Example 2.2.2. Consider a set $\mathbb{A} = \{0, \mathfrak{s}, \mathfrak{t}, \mathfrak{u}, \mathfrak{v}, 1\}$. Define a partial ordering "$\leq$" on $\mathbb{A}$, such that $0 \leq \mathfrak{s}, \mathfrak{t} \leq \mathfrak{u} \leq \mathfrak{v} \leq 1$ and the binary operations " $\mapsto$ "," $\hookrightarrow$ " and quasi complements " $^{-}$", " $\tilde{}$ " .Consider a fuzzy ζ on $\mathbb{A}$ as, $\zeta(\ell) = \begin{cases} 1 & \text{if } \ell = 1 \\ 0.4 & \text{Otherwise} \end{cases}$ for all $\ell \in \mathbb{A}$. Then, ζ is a SFIm.F of LPWA $\mathbb{A}$. Refer table in [4]

If $\zeta(\ell) = \begin{cases} 1 & \text{if } \ell, \mathfrak{v} = 1 \\ 0.2 & \text{Otherwise} \end{cases}$ for all $\ell \in \mathbb{A}$.

Then, ζ is not a SFIm.F of LPWA $\mathbb{A}$.

Proposition 2.2.3. A fuzzy set ζ of $\mathbb{A}$ is SFIm.F if and only if $\zeta(\ell) = \zeta\big((\ell \mapsto m) \hookrightarrow \ell\big)$ for all $\ell, m \in \mathbb{A}$.

Proof. Let ζ be a SIm.F of LPWA $\mathbb{A}$.

$\zeta(\ell) \geq \min\left\{\zeta(1), \zeta\left(1 \mapsto \big((\ell \mapsto m) \hookrightarrow \ell\big)\right)\right\} = \zeta(1 \mapsto (\ell \mapsto m) \hookrightarrow \ell)$

$\zeta(\ell) = \zeta\big((\ell \mapsto m) \hookrightarrow \ell\big)$.

Conversely, to prove ζ be aSIm.F of LPWA $\mathbb{A}$.

let $\zeta(\ell) = \zeta\big((\ell \mapsto m) \hookrightarrow \ell\big)$ for all $\ell, m \in \mathbb{A}$.

Clearly $\zeta(1) \geq \zeta(\ell)$

Since ζ is an Im.F of LPWA $\mathbb{A}$.

Consider $\zeta(m) = \zeta\big((m \mapsto n) \hookrightarrow m\big)$

$\zeta(m) \geq \min\left\{\zeta(\ell), \zeta\left(\ell \mapsto \big((m \mapsto n) \hookrightarrow m\big)\right)\right\}$ for all $\ell, m, n \in \mathbb{A}$.

Similarly, we prove that $\zeta(m) \geq \min\left\{\zeta(\ell), \zeta\left(\ell \hookrightarrow \big((m \hookrightarrow n) \mapsto m\big)\right)\right\}$ for all $\ell, m, n \in \mathbb{A}$.

Therefore, ζ be a SIm.F of LPWA $\mathbb{A}$.

Proposition 2.2.4. Let ζ and η be two SFIm.F's of a LPWA $\mathbb{A}$. Then $\zeta \times \eta$ is a SFIm.F in $\mathbb{A} \times \mathbb{A}$.

Proof. Let $(\ell, m) \in \mathbb{A} \times \mathbb{A}$. Since ζ and η be two SFIm.F's in $\mathbb{A}$.

We have

$(\zeta \times \eta)(1,1) = \min\{\zeta(1), \eta(1)\} \geq \min\{\zeta(\ell), \eta(m)\}$ for all $\ell, m \in \mathbb{A}$

$(\zeta \times \eta)(1,1) = (\zeta \times \eta)(\ell, m)$

Let$\big(\ell, \ell^{\star}\big), (m, m^{\star}), (n, n^{\star}) \in \mathbb{A} \times \mathbb{A}$,

$(\zeta \times \eta)(m, m^{\star}) = \min\{\zeta(m), \eta(m^{\star})\}$

$= \min\left\{\min\{\zeta(\ell), \zeta(\ell \mapsto (m \mapsto n) \hookrightarrow m)\}, \min\{\eta\big(\ell^{\star}\big), \eta\big(\ell^{\star} \mapsto (m^{\star} \mapsto n^{\star}) \hookrightarrow m^{\star}\big)\}\right\}$

$= \min\left\{\min\{\zeta(\ell), \eta\big(\ell^{\star}\big)\}, \min\{\zeta(\ell \mapsto (m \mapsto n) \hookrightarrow m), \eta\big(\ell^{\star} \mapsto (m^{\star} \mapsto n^{\star}) \hookrightarrow m^{\star}\big)\}\right\}$

$= \min\left\{(\zeta \times \eta)\big(\ell, \ell^{\star}\big), (\zeta \times \eta)\left(\big(\ell, \ell^{\star}\big) \mapsto \Big(\big((m, m^{\star}) \mapsto (n, n^{\star})\big) \hookrightarrow (m, m^{\star})\Big)\right)\right\}$

Similarly, we prove that$(\zeta \times \eta)(m, m^{\star})$

$= \min\left\{(\zeta \times \eta)\big(\ell, \ell^{\star}\big), (\zeta \times \eta)\left(\big(\ell, \ell^{\star}\big) \hookrightarrow \Big(\big((m, m^{\star}) \hookrightarrow (n, n^{\star})\big) \mapsto (m, m^{\star})\Big)\right)\right\}$

Thus $\zeta \times \eta$ is a SFIm.F of LPWA.

Proposition 2.2.5. Let ζ be a FIm.F of a LPWA $\mathbb{A}$ and ζ_{η} be the strongest fuzzy relation on $\mathbb{A}$. Then η is a SFIm.F of a LPWA $\mathbb{A}$ if and only if ζ_{η} is a SFIm.F of a LPWA of $\mathbb{A} \times \mathbb{A}$.

Proof. Let ζ be a FIm.F of a LPWA $\mathbb{A}$.

Then for any $(\ell, m) \in \mathbb{A} \times \mathbb{A}$

(i) We have $\zeta_{\eta}(\ell, m) = \min\{\eta(\ell), \eta(m)\} \leq \min\{\eta(1), \eta(1)\}$

$\zeta_{\eta}(\ell, m) \leq \zeta_{\eta}(1,1)$

(ii) Let $\big(\ell, \ell^{\star}\big), (m, m^{\star})$and $(n, n^{\star}) \in \mathbb{A} \times \mathbb{A}$

$\zeta_{\eta}(m, m^{\star}) = \min\{\eta(m), \eta(m^{\star})\}$

$\geq \min\left\{\min\{\eta(\ell), \eta(\ell \mapsto (m \mapsto n) \hookrightarrow m)\}, \min\{\eta\big(\ell^{\star}\big), \eta\big(\ell^{\star} \mapsto (m^{\star} \mapsto n^{\star}) \hookrightarrow m^{\star}\big)\}\right\}$

$= \min\left\{\min\{\eta(\ell), \eta\big(\ell^{\star}\big)\}, \min\{\eta(\ell \mapsto (m \mapsto n) \hookrightarrow m), \eta\big(\ell^{\star} \mapsto (m^{\star} \mapsto n^{\star}) \hookrightarrow m^{\star}\big)\}\right\}$

$$= \min\left\{\zeta_\eta(\ell,\ell^\star), \zeta_\eta\left((\ell \mapsto (m \mapsto n) \hookrightarrow m), (\ell^\star \mapsto (m^\star \mapsto n^\star) \hookrightarrow m^\star)\right)\right\}$$

$$= \min\left\{\zeta_\eta(\ell,\ell^\star), \zeta_\eta\left((\ell,\ell^\star) \mapsto ((m,m^\star) \mapsto (n,n^\star)) \hookrightarrow (m,m^\star)\right)\right\}$$

$$\zeta_\eta(m,m^\star) = \min\left\{\zeta_\eta(\ell,\ell^\star), \zeta_\eta\left((\ell,\ell^\star) \mapsto (m,m^\star)\right)\right\}$$

Similarly, we prove that

$$\zeta_\eta(m,m^\star) = \min\left\{\zeta_\eta(\ell,\ell^\star), \zeta_\eta\left((\ell,\ell^\star) \hookrightarrow (m,m^\star)\right)\right\}$$

Therefore ζ_η is a SFIm.F of LPWA of $\mathbb{A} \times \mathbb{A}$.

Conversely, let ζ_η is a SFIm.F of LPWA of $\mathbb{A} \times \mathbb{A}$.

Then, $\eta(1) = \min\{\eta(1), \eta(1)\} = \zeta_\eta(1,1) \geq \zeta_\eta(\ell,\ell) = \min\{\eta(\ell), \eta(m)\} = \eta(\ell)$

$\eta(1) \geq \eta(\ell)$ for all $\ell \in \mathbb{A}$.

Let $\ell, m, n \in \mathbb{A}$.

Then $\eta(m) = \min\{\eta(m), \eta(1)\} = \zeta_\eta(m,1)$

$$\geq \min\{\zeta_\eta(\ell,1), \zeta_\eta((\ell \mapsto (m \mapsto n) \hookrightarrow m), (1 \mapsto (1 \mapsto n^\star) \hookrightarrow 1))\}$$

$$= \min\{\zeta_\eta(\ell,1), \zeta_\eta((\ell \mapsto (m \mapsto n) \hookrightarrow m), 1)\}$$

$$= \min\{\min\{\eta(\ell), \eta(1)\}, \min\{\eta(\ell \mapsto (m \mapsto n) \hookrightarrow m), \eta(1)\}\}$$

$$\eta(m) \geq \min\left\{\eta(\ell), \eta\left(\ell \mapsto ((m \mapsto n) \hookrightarrow m)\right)\right\}$$

Similarly, we prove that

$$\eta(m) \geq \min\left\{\eta(\ell), \eta\left(\ell \hookrightarrow ((m \hookrightarrow n) \mapsto m)\right)\right\}$$

Therefore, η is a SFIm.F of a LPWA $\mathbb{A}$.

2.3 NSFIm.F of LPWA

We introduce NSFIm.F of LPWA in this part and use examples to look into some of their properties.

Definition 2.3.1. A non-constant FIm.F ζ of LPWA $\mathbb{A}$ is called as normal strong fuzzy, if $\zeta(\ell) = \zeta(1)$ for all $\ell \in \mathbb{A}$.

Proposition 2.3.2. Let ζ be a SFIm.F of LPWA $\mathbb{A}$, define a fuzzy set $\zeta^\star$ in $\mathbb{A}$ as $\zeta^\star(\ell) = \zeta(\ell) + 1 - \zeta(1)$ for all $\ell \in \mathbb{A}$. Then $\zeta^\star$ is NSFIm.F ζ of $\mathbb{A}$ such that $\zeta \subseteq \zeta^\star$.

Proof.

(i) Let $\zeta^\star(1) = \zeta(1) + 1 - \zeta(1) = 1 \geq \zeta^\star(\ell)$

$\zeta^\star(1) \geq \zeta^\star(\ell)$

(ii) To prove $\zeta^\star(m) = \zeta(m) \geq \min\left\{\zeta^\star(\ell), \zeta^\star\left(\ell \mapsto ((m \mapsto n) \hookrightarrow m)\right)\right\}$

Now $\zeta^\star(m) = \zeta(m) + 1 - \zeta(1)$

$$\geq \min\left\{\zeta(\ell), \left(\zeta\left(\ell \mapsto ((m \mapsto n) \hookrightarrow m)\right)\right)\right\} + 1 - \zeta(1) \quad \text{(By reference[4])}$$

$$= \min\left\{\zeta(\ell) + 1 - \zeta(1), \zeta\left(\ell \mapsto ((m \mapsto n) \hookrightarrow m)\right) + 1 - \zeta(1)\right\}$$

Thus $\zeta^\star(m) \geq \min\left\{\zeta^\star(\ell), \zeta^\star\left(\ell \mapsto ((m \mapsto n) \hookrightarrow m)\right)\right\}$

(iii) To prove that $\zeta^\star(m) = \zeta(m) \geq \min\{\zeta^\star(\ell \hookrightarrow m), \zeta^\star(\ell)\}$

Now $\zeta^\star(m) = \zeta(m) + 1 - \zeta(1)$

$$\geq \min\left\{\left(\zeta\left(\ell \hookrightarrow ((m \hookrightarrow n) \mapsto m)\right), \zeta(\ell)\right)\right\} + 1 - \zeta(1) \quad \text{(By reference[4])}$$

$$= \min\left\{\zeta(\ell) + 1 - \zeta(1), \zeta\left(\ell \hookrightarrow ((m \hookrightarrow n) \mapsto m)\right) + 1 - \zeta(1)\right\}$$

$$\zeta^\star(m) = \min\left\{\zeta^\star(\ell), \zeta^\star\left(\ell \hookrightarrow ((m \hookrightarrow n) \mapsto m)\right)\right\}$$

Thus $\zeta^\star$ is a SFIm.F of LPWA $\mathbb{A}$

Clearly $\zeta^\star(\ell) = \zeta^\star(1)$ for all $\ell \in \mathbb{A}$.

Therefore $\zeta^\star$ is NSFIm.F of LPWA $\mathbb{A}$

So it is clear that $\zeta(\ell) \subseteq \zeta^\star(\ell)$ for all $\ell \in \mathbb{A}$.

Proposition 2.3.3. Let ζ be a SFIm.F of a LPWA $\mathbb{A}$ and $\eta: [0,\zeta(1)] \mapsto [0,1]$ an increasing function. Let ζ_η be a fuzzy set in $\mathbb{A}$ defined as $\zeta_\eta(\ell) = \eta(\zeta(\ell))$ for all $\ell \in \mathbb{A}$. Then ζ_η is SFIm.F of a LPWA $\mathbb{A}$. Moreover, if ζ is normal, then ζ_η is also NFIm.F of LPWA.

Proof. Let η is increasing and $\zeta(1) \geq \zeta(\ell)$ for all $\ell \in \mathbb{A}$.
We have $\zeta_\eta(1) = \eta(\zeta(1)) \geq \eta(\zeta(\ell)) = \zeta_\eta(\ell)$ for all $\ell \in \mathbb{A}$.
Let $\ell, m, n \in \mathbb{A}$
Consider, $\zeta_\eta(m) = \eta(\zeta(m)) \geq \eta\left(\min\left\{\eta(\ell), \eta\left(\ell \mapsto ((m \mapsto n) \hookrightarrow m)\right)\right\}\right)$

$$= \min\left\{\eta(\zeta(\ell)), \eta\left(\zeta\left(\ell \mapsto ((m \mapsto n) \hookrightarrow m)\right)\right)\right\}$$

Thus, $\zeta_\eta(m) = \min\left\{\zeta_\eta(\ell), \zeta_\eta\left(\ell \mapsto ((m \mapsto n) \hookrightarrow m)\right)\right\}$ for all $\ell, m, n \in \mathbb{A}$.
Similarly, we show that

$$\zeta_\eta(m) = \min\left\{\zeta_\eta(\ell), \zeta_\eta\left(\ell \hookrightarrow ((m \hookrightarrow n) \mapsto m)\right)\right\} \text{ for all } \ell, m, n \in \mathbb{A}.$$

Therefore, ζ_η is SFIm.Fof a LPWA $\mathbb{A}$.
Moreover, if ζ is normal, then clearly $\eta(\zeta(1)) = \eta(1)$.
Sinceη is increasing in $[0,\zeta(1)]$.
Obviously, $\zeta(1) = 1$.
Hence, $\zeta_\eta(1) = \eta(\zeta(1)) = 1$.
Therefore, ζ_η is also NFIm.F of LPWA $\mathbb{A}$.

3.CONCLUSION

The notion of strong and SFIm.Fs of LPWA is introduced in this study, and some of their properties are explained with demonstrations.

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RESEARCH ARTICLE

Effectiveness of Cervical Core Stability Exercises on Gripping Performance in Young Adult Batsmen: A Randomized Control Trial

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ABSTRACT

Cricket is a game of strength and endurance, which demands high level of fitness and skills like upper limb power, and grip strength. The most common types of injuries are fractures, dislocations and contusions, specially finger injuries. Improvement of hand strength is very essential for better performance in sports that involves hand activity. Cervical core muscles are important for maintaining normal posture and stability of cervical spine and shoulder posture which transfer the forces to upper extremity and improve athletic function. The aim of present study is to investigate the effect of cervical core stability training on gripping performance in young adult batsmen. Total 36 cricket players (batsmen) were selected for study. participants were divided into experimental group and control group, Eighteen players in each group. Group A were given cervical core stability training and grip strengthening exercises and group B were given grip strengthening exercises for 5 days per week to 4 weeks. Hand held dynamometer for grip assessment and pressure biofeedback unit for the core strength and endurance were taken as an outcome measure for the study. For statistical analysis, within group comparison Wilcoxon signed rank test and between group comparison Mann-Whitney U test was applied. The result shows group A and group B were significantly effective, but group A has shown statistically more significant improvement in grip strength and cervical core strength and endurance than group B. Both the techniques were effective however; the cervical core stabilization group was suggesting more improvement than control group.

Keywords: Cervical core, Batsmen, Gripping, DCF, AS,PI

INTRODUCTION

Cricket is the most popular sport in India for both men and women, and it is enjoyed by people of all ages. Cricket is an endurance and strength sport that requires fitness and abilities such as upper limb strength and grip strength (bat and ball grip) to compete well [1]. Players' greater physical demands may raise the chance of injury[2]. In studies of the British Sports Council, the Australian Cricket Board, and the South African Cricket Club, the occurrence of cricket injuries within a season was discovered [3]. Fractures, dislocations, and contusions, particularly to the fingers, are the most common injuries received when batting (20, 5 percent) [4]. Seasonal injuries in bowlers (42%) and fielders (40%) were greater than among batsmen (17,1 percent). Injury rates were higher among younger players (26,2 years) than among older players. The upper limb (34,1%) and lower limb (37,5%) were both mentioned [4]. Power grip is a forceful movement that is very essential part of batting in cricket [5]. Grip strength is a significant predictor of athletic performance in a variety of sports. One of the motor skills in cricket is hand grip strength. Hand strength development is critical for improved performance in sports that require grip and hand activity [6]. Grip strength is a measurable indicator of upper-limb functional integrity [7]. Batting is defined as a dynamic action and a player's ability to deliver information, to choose and accomplish proper response. The goal of attacking cricket strokes, like front-foot drive, is to strike the ball with enough force to score runs, a cut while keep going control of ball. Batting includes grip, stance, initial movement, back lift, forward stride, downswing, bat ball impact and follow through[8]. Cores are essentially required in sports because it provides "proximal stability for distal mobility." During sports performance, the core musculatures maintain the integrity of the spine and pelvis, as well as produce and transfer forces from big to small parts of the body[9]. Core muscle strength is essential for functional motions, and a lack of strength can lead to injury [9]. The spine is an important component of the kinematic chain because it distributes forces from the lower to the higher limbs. The ability to manage the position and movement of the torso for optimal force production, transfer, and control of forces to and from the distal portions during activities is known as core stability. The players' main tool for manipulating the surroundings is their core strength and upper extremities. In the upper limb, mobility takes precedence over stability. The hand is the most crucial component in the upper limb for mobility and usefulness [10]. For core stability, a well-functioning neuromuscular system, enough muscle strength, endurance, neuromuscular control and motor responses are required [11]. As a result, if muscle recruitment is impaired, the equilibrium between the front and rear stabilisers of the neck will be disrupted [12]. Cervical stabilisation exercises have been employed to assist train the deep stabiliser muscles of the cervical spine and enhance synergy between superficial and deep muscles [13]. The deep cervical flexors (for example, the longus capitis) provide stability [14]. Fatigue and muscle spasm are caused by the overactivity of superficial muscles. As a result, physiotherapy focuses on minimising fatigue and preventing excessive activation of these muscles. The use of a hand-held dynamometer tis the most popular method of assessing grip strength. It has been discovered to be a very reliable strategy. It has been recommended that pressure biofeedback unit (PBU) to test (cervical core) the DCF muscles strength and endurance is a more effective and cost-effective method of which showed a high level of intertester dependability. Several research and literatures have found that cervical stabilisation workouts improve DCF endurance and neck pain-related impairments. Core stability training has recently been suggested as a way to improve player performances. Based on this available information present study is aimed to find the relation between cervical core and upper extremity as there is paucity of literature that found the connection between cervical core and hand grip and function. Hence, the purpose of the study is to investigate the effect of cervical core stabilization exercises on gripping performances in young adult cricketers (batsmen).

MATERIALS AND METHODOLOGY

This Randomized Control Trial study has been conducted at Universal Cricket Academy, 36 Cricket Players (batsmen) of age group between 18 to 30 years were taken. Inclusion Crieteria are, Male cricket players (Batsmen), Players regularly playing cricket 3 to 4 hours for 6 days a week, Players playing cricket from last 3 years or more and still playing cricket state level or national level, Willingness of participants. Exclusion Crieteria are Any recent injuries or disease / unable to play or practice, History of surgery that affect upper extremity strength, Upper

extremity injury or past surgical history of upper extremity, Players having any musculoskeletal trauma, Any past history of neurological involvement of upper extremity, Orthopaedic conditions spondylolisthesis, neck pain, shoulder pain, deformity, Presenceof neurological diseases migraine, radiculopathy, neuropathy ,Cardiovascular diseases hypertension, peripheral heart diseases, Uncooperative players.

PROCEDURE

A randomized control trial study was approved by an Ethical Committee IECHR-SAINAT HOSPITAL /AHMC / 15. A study was conducted at universal cricket academy, 36 subjects (18 to 30 years old) will be selected on the basis of inclusion criteria and divided into 2 group. Group A (16): experimental group was received cervical core stability training along with traditional grip strengthening exercises. Group B (16): control group was received grip strengthening exercise regime. In initial evaluation session, the players were assessed by baseline outcome. cervical core strength was measured by pressure biofeedback unit and hand grip strength measurements was done by hand held dynamometer. Nature and purpose of the study was explained to the patient and informed consent in vernacular language was e taken prior to the study, and subjects were informed about the need of the study.

Outcome measurement

Grip strength was assessed by hand-held dynamometer. It has been discovered to be a very reliable strategy. (ICC values range from 0.85-0.98) [15] A biofeedback pressure unit (Stabilizer Pressure Biofeedback-Chattanooga Stabilizer) [17]. was used to test (cervical core) the DCF muscles strength and endurance, which showed a high level of intertester reliability (ICC 0.81 for the activation score and 0.93 for the performance index) [16]. Pre and post measurements were taken for the assessment.

Group A (Intervention): Cervical core stabilization exercises

Starting in the supine position, stability exercises move to sitting, standing with the back against a wall, and standing without support. Throughout all of the stability exercises, the participants were instructed to maintain their positions and contractions [19] With 10 repetitions, participants hold the contraction for 10 seconds in each position. For four weeks, the entire programme was carried out five days a week [19]. Extremity ROM activities will be performed while maintaining a stable spine. Stability exercises begin in a supine posture and progress to a standing position [19]. craniocervical flexion is maintained while performing every exercises like deep cervical extensor exercises with Thera bend in prone lying, upper extremity PNF patterns with Thera-Band in sitting, neck isometric flexion/extension/lateral flexion (ball between head and wall),Y exercises and rowing exercises and Deep cervical extensors exercise with Thera band in standing position. Control group was given Grip strengthening exercises 5 days a week, 20 repetitions by using hand gripper, thera putty and disc. Pre and post data were taken and statistical analysis was conducted on it.

RESULT AND STATISTICAL ANALYSIS

A total number of 36 players were undergone for the pre and post intervention assessment. All statistical analysis was carried out in SPSS windows version 26.0. The normality of distribution for quantitative data was assessed using the Shapiro- wilk test. Paired t test (Wilcoxon signed rank test) is done for the within group comparison and independent t test (Mann-Whitney test) is done for the between group differences in baseline data. Statistical significance was set at an alpha of 0.05 for all analysis all 36 participants assessed by the pre and post outcome measurement. Within group comparison made statistical difference between pre and post outcome measurement. In group A pre and post grip strength, activation score mean performance index was given below in table. In group B pre and post grip strength activation score performance index mean was given in table below. That shows significant improvement in all outcome measurement. Group A and B has shown statistically significant improvement in all outcomes (p is less than 0.05) While, between group comparison, for group A and B there was change in mean grip strength, activation score and performance index as shown in the. this shows that there is statistically significant improvement in grip strength, activation score and performance index in group A (p =0.000) comparing to group B.

hence both the group has shown significant improvement in outcomes, while comparing between group mean differences group A has shown statistically more significant improvement than B

DISCUSSION

In the present study total 36 cricket players(batsmen) of age group between 18 to 30 were taken. Subjects were asked to perform cervical core stability exercises and grip strengthening exercises for the 4 weeks. their grip strength and cervical core strength was measured before and after intervention by dynamometer and PBU. Result of our study as shown in table are mean values for within group and between group, pre and post grip strength, activation score and performance index have statistical differences in both the groups. However, there is an improvement in hand grip strength in cervical core stability group. The core is the central part, according to W. Ben Kibler's opinion in The Role of Core Stability in Athletic Function. It acts as the stability base and the 'engine of force generation, as well as a controller to manage the force.[18]In normal sports activities, core stability is essential. as a highly integrated multi-segment activation that enables interactive movements while also providing force generation and proximal stability for distal mobility [11]. The goal of the Cervical Stability Exercise with Chin Nodding is to flatten the curvature of the cervical spine without moving the head. It is used to build muscle strength as a therapeutic exercise. Several proprioceptors are distributed over the DCFs muscle. Cervical core stability exercises produce contraction of DCFs muscles and improve the performance. In the cervical area, the deep neck flexors play a significant role in segmental control and support. When there are diseased or injured joints, the muscular system has the innate ability to compensate for any loss of passive structure integrity. Adding stabilising movements to a typical cervical exercise programme, according to Nihal Gelecek et al, yields similar gains in pain intensity, grip strength, disability levels, and quality of life. Cervical stability exercises that are safe to undertake can be utilised to improve cervical stability.

Furthermore, these workouts can help you improve your mobility, spinal alignment, and sensorimotor function. In a study titled "Effects of core stability exercises on grip strength and manual dexterity in individuals with persistent neck pain," M Soysal Tomruk et al came to the same conclusion. The study concluded that core provided more effect to hand strength, the result of this study agreed with present study. Mohamed Faisal and his colleagues suggested their findings, involvement of the lower cervical segments causes severe weakness of the intrinsic muscles of the hand, resulting in a major loss of grip strength Result of this study is similar with present study. The mechanism behind the change could be It may modify the spinal curvature and give spinal stability, recognised sensorimotor control, and input postural information during head or upper limb movement using cervical core stability training. Because the core is the most central component of the body, it provides both proximal and distal stability and mobility. As a result, it generates force and power, which it then transfers to the extremities. It necessitates muscle strength and endurance, as well as neuromuscular control that can quickly integrate sensory data with internal and external data and adjust motor responses. In this current study, we reported that both the group has shown improvement in all outcomes. But comparing both the group, cervical core stability has shown more improvement in grip strength, AS and PI than control group. So, here in present study it shows that cervical core stability exercises have shown more improvement in all outcomes compare to the control group. So, here the null hypothesis is rejected and, alternative hypothesis is accepted.

CONCLUSION

The study concluded that Both the techniques cervical core stability training and grip strengthening were individually effective however, the cervical core stabilization group was suggesting more improvement in all outcome than control group.

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Table: 1 Mean age group

Characteristics	Group A	Group B
Age(Mean ± SD)	21.1667±3.41709	23.7222±3.90784

Table: 2 Within group comparison

Variables		Group A mean, SD	t	p
Grip	Pre	76.3889± 16.96064	11.820	.000
	Post	112.2222±12.62843		
AS	Pre	6.1111±1.27827	11.747	.000
	post	8.8889± 1.02262		
PI	Pre	45.2222±9.63178	13.120	.000
	post	81.2222±13.19784		
variables		**Group B mean, SD**	**t**	**p**
Grip	Pre	74.7222± 17.52915	7.512	.000
	Post	91.6667±15.04894		
AS	Pre	5.7778±1.16597	3.007	.008
	Post	6.8889± 1.84355		
PI	Pre	38.6667±9.35572	6.173	.000
	Post	46.5556±9.24962		

Table: 3 Between group comparison for changes in Grip, AS, PI

Groups	Grip		t value	p value
	Mean	**SD**		
A	112.2222	12.62843	4.439	.000
B	91.6667	15.04894		
Groups	**AS**		**t value**	**p value**
	Mean	**SD**		
A	8.8889	1.02262	4.025	.000
B	6.8889	1.84355		
Groups	**PI**		**t value**	**p value**
	Mean	**SD**		
A	81.2222	13.19784	9.126	.000
B	46.5556	9.24962		

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RESEARCH ARTICLE

Effect of Organic Formulations on Germination and Seedling Growth of Garden Balsam (*Impatiens balsamina)*

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ABSTRACT

The investigation was made in the Department of Horticulture, Faculty of Agriculture, Annamalai University to find out the effect of Organic Formulations on germination and seedling growth of garden balsam. The experiment was laid out in completely randomized block design (CRBD) with 13 treatments and 3 Replications. Seeds soaked with panchagavya @ 3 per cent for 1, 2 and 3 hours of soaking, vermiwash @ 10, 20 and 30 per cent for 5 hours of soaking, humic acid 0.5%,1%,1.5% at 24 hours soaking, water soaking for 8, 12, 16 hours and the control was maintained by the seeds without any treatment. Among the various treatments of garden balsam seedling, T_6- 3% panchagavya @ 2 hours soaking was found to be the best with 90.26 percentage of germination, 10.70 cm of shoot length, 1.42 cm of root length and 1.91 g of seedling weight. This was followed by T_8 - 10 % vermiwash @ 5 hours soakings with the values of 85.15, 8.92 cm, 1.39 cm and 1.79 g of germination percentage, shoot length, root length, seedling weight and leaves per seedling respectively while the minimum was recorded in the control (45.35%, 4.12cm,0.97and 0.5g).

Keywords: garden balsam, panchagavya, vermiwash, humic acid, germination, seedling

INTRODUCTION

Impatiens balsamina, is a rainy season annual plant growing to 20–75 cm tall, with a thick, but soft stem commonly known as garden balsam, rose balsam, spotted snap weed and native to India and Myanmar. It prefers partial shade and belongs to the family Balsaminaceae. It covers a wide variety of forms and tones. Garden balsam requires 60 to 70 days from sowing to produce flowers, so an early start is essential. The flowers bear double petals and come in an array of colours but are partially hidden by large attractive leaves with pronounced veins.Garden balsamcome in white, red, orange, violet and pink. Among the various methods for inducing germination and seedling growth, seed treatment with panchagavya, vermiwash and humic acid play a significant role. Panchagavya means "mixture of five products (cow dung, cow urine. Milk, ghee and curd) of cow". Of these, the three direct constituents are cow dung, cow urine and milk and the two derived products are curd and ghee. Panchahavya is also used as fertilizer and pesticide in agricultural operations. It is an organic product recommended for crop improvement in organic agriculture (Sangeetha and Thevananthan, 2010). It is used as a foliar spray, soil application along with irrigation, as well as seed treatment (Natarajan, 2002). Panchagavya has resulted in positive effect on growth and productivity of crops as reported by Somasundaram *et al.*, (2007).Vermiwash is an organic fertilizer obtained from units of vermiculture and vermicompost as drainage. It is used both as foliar spray and in the root zone of plant. It contains enzymes, secretions of earthworms which would stimulate the growth and yield of crops and even develop resistance in crops receiving this spray(Atiyeh *et al*., 2002).It protects the environment from various chemical fertilizers. It is used as a liquid major nutritive and enzymatic element for promoting growth of all green plants. It extracted body fluid of earthworms is further nutrient rich with components promoting good plant-growth (Anand *et al*., 1995). Humic acid increases nutrient uptake, drought tolerance and seed germination. It increases the microbial activity in the soil, making it an excellent root stimulator. Humic acid increases the availability of nutrients in fertilizers and those already existing in the soil.With the above facts in mind, the present investigation was carried out to study the effect of different concentrations and soaking duration of organic formulations on germination and seedling growth of garden balsam.

MATERIALS AND METHODS

The experiment entitled "Effect of organic formulations on germination and seedling growth of garden balsam (*Impatiens balsamina*)" was carried out in the Department of Horticulture, Faculty of Agriculture, Annamalai University. The experiment was laid out in completely randomized block Design (CRBD) with 13 treatments and three replications. The garden balsam seeds were obtained from the private vendor at Sivapuri village near Annamalainagar during the entire period of study. The seeds are soaked in 3 % of panchagavya for 1, 2 and 3 hours, Humic acid 0.5, 1 and 1.5% for 24 hours, Vermiwash 10, 20 and 30 % for 5 hours and water soaking for 8, 12 and 16 hours along with control. After the required period of soaking the seeds are taken out and transferred to plant in media. The media used in this study was soil, sand and organic matter with the ratio of 1:1:1. The treatments were T_1 - control, T_2 - 0.5 % humic acid @ 24 hours soaking, T_3 - 1 % humic acid @ 24 hours soaking,T_4 - 1.5 % humic acids @ 24 hours soaking, T_5 - 3 % panchagavya @ 1 hour soaking, T_6 - 3 % panchagavya @ 2 hours soaking, T_7 - 3 % panchagavya @ 3 hours soaking, T_8 - 10 % vermiwash @ 5 hours soaking, T_9 - 20 % vermiwash @ 5 hours soaking, T_{10} - 30 % vermiwash @ 5 hours soaking,T_{11} - water soaking @ 8 hours, T_{12} - water soaking @ 12 hours, T_{13} - water soaking @ 16 hours. Data on percentage of germination, shoot length, root length and seedling weight were recorded in all treatments.

RESULTS AND DISCUSSION

The statistical analysis of data revealed that effect of different concentration of organic formulations on the germination and seedling growth of garden balsam were significant (table 1). Among the various treatments, T_6 - 3 % panchagavya @ 2 hours soaking hours soaking was found to be the best with 90.26 percentage of germination, 10.70 cm of shoot length, 1.42 cm of root length and 1.91 g of seedling weight. This was followed by T_8 - 10 % vermiwash @

5 hours soakings with the values of 85.15, 8.92 cm, 1.39 cm and 1.79 g of germination percentage, shoot length, root length, seedling weight and leaves per seedling respectively while the minimum was recorded in the control (45.35%, 4.12cm, 0.97cmand 0.5g). This might be due to the presence of plant growth promoting substances produced by bacteria that are present in panchagavya (Naik and Sreenivasa, 2009). 2009). Microbes such as *Rhizobium*, azotobacters, *Azospirillum,* phosphorus solubilizing bacteria, *Trichoderma* and *Pseudomonas* present in panchagavya act as liquid bio-fertilizer and bio-pesticides. Sometimes shoot length and root length were reduced with increasing concentration levels and duration with organic fortification which might be due to optimal dose of the organic product which is normally specific to crop (Sumangala and Patil, 2009).The results are in close conformity with the findings of Emily (2003) in *Withania somnifera* (L) Dunal and Srimathi *et al*. (2013) in Jatropha and Pungamia.

CONCLUSION

It may be concluded from the result that, 3% panchagavya @ 2 hours soaking showed maximum germination percentage, shoot length, root length and seedling weight.

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Table 1. Effect of organic formulations on germination and seedling growth of garden balsam

Treatment	Germination percentage	Shoot length (cm)	Root length (cm)	Seedling weight (g)
T_1	45.35	04.12	0.97	0.50
T_2	65.40	06.25	1.20	1.20
T_3	70.89	06.81	1.24	1.31
T_4	75.62	07.62	1.26	1.43
T_5	53.81	05.13	1.12	0.84
T_6	90.26	10.70	1.42	1.91

T_7	55.45	05.45	1.13	0.97
T_8	85.15	08.92	1.39	1.79
T_9	83.62	08.55	1.35	1.65
T_{10}	50.25	04.91	1.03	0.73
T_{11}	80.38	08.36	1.31	1.54
T_{12}	60.25	05.93	1.18	1.08
T_{13}	48.76	04.56	1.02	0.61
SEd	0.90	0.10	0.07	0.05
CD (p=0.05)	1.84	0.22	0.14	0.10

T_1 - control, T_2 - 0.5 % humic acid @ 24 hours soaking, T_3 - 1 % humic acid @ 24 hours soaking, T_4 - 1.5 % humic acids @ 24 hours soaking, T_5 - 3 % panchagavya @ 1 hour soaking, T_6 - 3 % panchagavya @ 2 hours soaking, T_7 - 3 % panchagavya @ 3 hours soaking, T_8 - 10 % vermiwash @ 5 hours soaking, T_9 - 20 % vermiwash @ 5 hours soaking, T_{10} - 30 % vermiwash @ 5 hours soaking, T_{11} - water soaking @ 8 hours, T_{12} - water soaking @ 12 hours, T_{13} - water soaking @ 16 hours

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RESEARCH ARTICLE

Comparative Analysis of Optical and Mechanical Behaviour of AA2024 T3 Aluminium and ZE41A Magnesium Alloys with Threaded and Taper Cylindrical FSW Tools

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ABSTRACT

The joining of similar AA2024 aluminum plates of 6 mm thickness was carried out by friction stir welding (FSW) with constant parameter and taper cylindrical, threaded tools. Two different tool designs have been employed to analyze the influence of rotation speed traverse speed and axial fore over the microstructural and tensile properties. In FSW technique, the process of welding of the base material, well below its melting temperature, has opened up new trends in producing efficient similar joints. Effect of welding speed on microstructures, hardness distribution and tensile properties of the welded joints were investigated. By varying the tool profile, defect free and high efficiency welded joints were produced. During the same parameter through threaded tool profile the weld was achieved minimum hardness and maximum tensile strength. Bead appearance and angle distortion were compared than good on taper cylindrical pin. Optical microscope shows welded with threaded profile tool the precipitates are completely deformed by the high heat and nugget zone shows the fine grains to enumerate the zone. But the same time with taper cylindrical profile tool the precipitates are completely deformed by the high heat and nugget zone shows the fine grains equilibrium and grain morphology are isolated transformed grains.

Keywords: H13, AA2024, FSW tool, Tool traverse, Tensile strength

INTRODUCTION

FSW creates a weld joint without bulk melting. Compared to the widely used fusion welding processes (e.g., arc welding, laser welding), an inherent advantage of FSW is that it is immune to the defects and property deteriorations associated with solidification. Solidification cracking, porosity, and melting and coarsening of strengthening phases are eliminated in FSW. In addition, the extensive thermo mechanical deformation of FSW refines the microstructure of the weld region. Hence, whereas fusion welding generally results in weld property degradation, FSW can produce a weld with mechanical properties like or even better than those of the base metal. For example, as shown in Figure 3, the impact energy absorption of a friction stir weld is much higher than the base metal of a commercial pipeline steel. A very attractive application is FSW of steel plate for shipbuilding applications, based primarily on the reduction of welding distortion, but the development of low-cost welding equipment and more robust welding tool materials is required before this application can be exploited have applied the method of applying the role of tool geometry to steels.

LITERATURE REVIEW

Rajkumar [1] et.al was deals with the characterization of friction stir welded dissimilar Aluminum alloys AA 5052 and AA5052. Correlating mechanical and metallurgical properties it is deduced that the sample welded at lower feed rate performed better in terms of ductility. Sadeesh Pa [2] et.al were carried out by friction stir welding (FSW) technique. Optimum process parameters were obtained for joints using statistical approach. R. K. Kesharwania, [3] et.al were executed optimization of parameters affecting weld quality in tailored friction stir butt welding of 2.0 mm thin dissimilar sheets of AA5052-H32 and AA5754-H22 using Taguchi grey based approach. M. Ilangovan [4] et.al were analyzed Joints between two different grades of aluminum alloys are need of the hour in many lightweight military structures. The increase in hardness is attributed to the formation of fine grains and intermetallics in the stir zone, and in addition, the reduced size of weaker regions, such as TMAZ and HAZ regions, results in higher tensile properties. K. Kimapong [5] et.al were investigated the effects of pin rotation speed, position of the pin axis, and pin diameter on the tensile strength and microstructure of the joint. N. T. Kumbhar [6] et.al were carried out at various combinations of tool rotation speeds and tool traverse speeds. The transverse cross-section of the weld was used for optical as well as electron microscopy observations. W H Jiang [7] et.al were demonstrates that friction stir welding (FSW) is a feasible route for joining 5052 aluminum (Al) alloy to AISI 1018 steel. The weld has a good weld quality and is free of cracks and porosity. Vukčević Milan [8] et.al were analyzed mechanical parameters in friction stir welding process is current and insufficiently explored, it is particularly present considering the class of aluminum alloy series 6000 (Al Mg Si). A Boșneag [9] et.al was experimentally studied which includes welding three dissimilar aluminum alloys, with different properties, used in aeronautics industry, these materials are: AA 2024, AA5052 and AA7075. K.V.P.P Chengdu, [10] et.al were analyzed in many industrial applications, steels are readily replaced by non-ferrous alloys, in most cases by aluminum alloys. The main aim of goal is to satisfy the mechanical properties of Al alloy5052 like yield strength, ultimate tensile strength, and percentage of elongation etc. by using FSW technique.

MATERIALS AND METHODS

2024 aluminum is heat-treatable aluminum alloy with copper as the primary alloying element. It is malleable when in the fully soft, annealed temper and can be heat-treated to high strength levels after forming. Due to its high strength to weight ratio, it is widely used in aerospace applications. TC test plates only slightly higher than the other value of hardness Parameter Vs Hardness Very High tensile strength obtained with Threaded tool profile pin compared than Taper Cylindrical tool profile pin. In our experimental we found very fine finish obtained at taper Cylindrical with parameter speed of -1000 RPM, tool traverse-20mm/min and axial force-10KN. coarse bead appearance obtained at threaded tool profile

Microstructure Analysis

Microstructure analysis evaluated through optical microscope with 100x magnification (Figure 6). Microstructure of AA2024 by using Threaded Profile, Magnification: 100X Etchant: H.F and Keller's Reagent, Microstructure of AA2024 by using Taper Cylindrical Profile (Figure 7).

RESULT AND CONCLUSION

The FSW process were executed on AA 2024 with Taper cylindrical and threaded tool profile with constant parameters and compared various mechanical and optical properties. In addition, tool pin profile has also influenced the weld quality. From this research work. During the same parameter through threaded tool profile the weld was achieved minimum hardness and maximum tensile strength. Bead appearance and angle distortion were compared than good on taper cylindrical pin. Optical microscope shows welded with threaded profile tool the precipitates are completely deformed by the high heat and nugget zone shows the fine grains to enumerate the zone. But the same time with threaded profile tool the precipitates are completely deformed by the high heat and nugget zone shows the fine grains are equilibrium and grain morphology are isolated transformed grains.

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Table: 1. Typical chemical composition for aluminum alloy 2024

Element	Percentage
Si	Max 0.5
Fe	Max 0.5
Cu	3.8-4.9
Mn	0.3-0.9
Mg	1.2-1.8
Zn	Max 0.25
Ti	Max 0.15
Cr	Max 0.1
Al	90.7-94.7

Table: 2. Mechanical Properties

Density	2.78 g/cc
Melting Point	502^0C
Modulus of Elasticity	73.1 Gpa
Thermal conductivity	180 W/m.K
Thermal expansion	12 x 10^{-6} /K
Electrical resistivity	5.82 x10^{-6} Ω.m

Table: 3. Levels and ranges of FSW process parameters

SPEED RPM	TOOL-TR Mm/min	AXFC KN	TOOL PROFILE
1000	20	10	Taper Cylindrical
1000	20	10	Threaded

Table: 4. hardness value –HRB value

SAMPLES	TAPER CYL	THREADED
AA2024	60	55

Table: 5. Tensile strength value

SL.NO	SPEED RPM	TOOL-TR Mm/min	AXFC KN	Tensile Strength N/mm²	TOOL PROFILE
T_1	1000	20	10	53.832	Taper Cylindrical
T_2	1000	20	10	96.930	Threaded

Table: 6. Weld appearances

SL.NO	TOOL PROFILE	SPEED RPM	TOOL-TR Mm/min	AXFC KN	RESULT
T_1	**TAPER CYL**	1000	20	10	Very smooth bead appearance, no crack & porosity
T_2	**THREADED**	1000	20	10	Coarse bead appearance, no crack & porosity

Figure: 1. Vertical Milling Machine

Figure: 2. Taper Cylindrical & Threaded tool pin profile

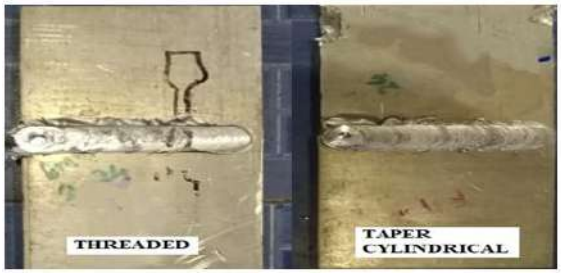


Figure: 3. FSW Various Tool Plates

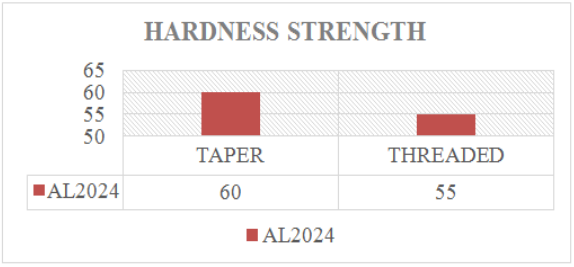
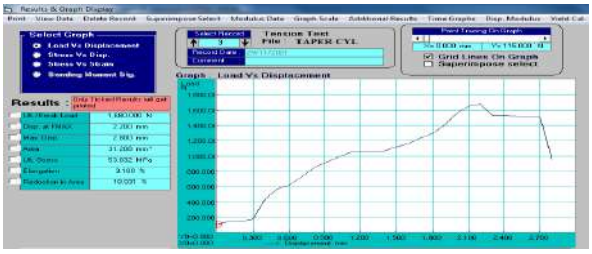


Figure: 4. hardness strength graph



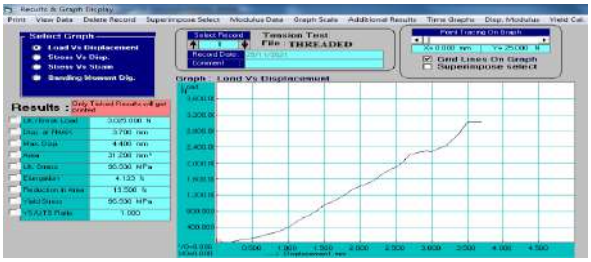


Figure: 5. Tensile strength graph

Magnification: 100X Etchant: H.F and Keller's Reagent

Figure 6: Microstructure of AA2024 by using Threaded Profile

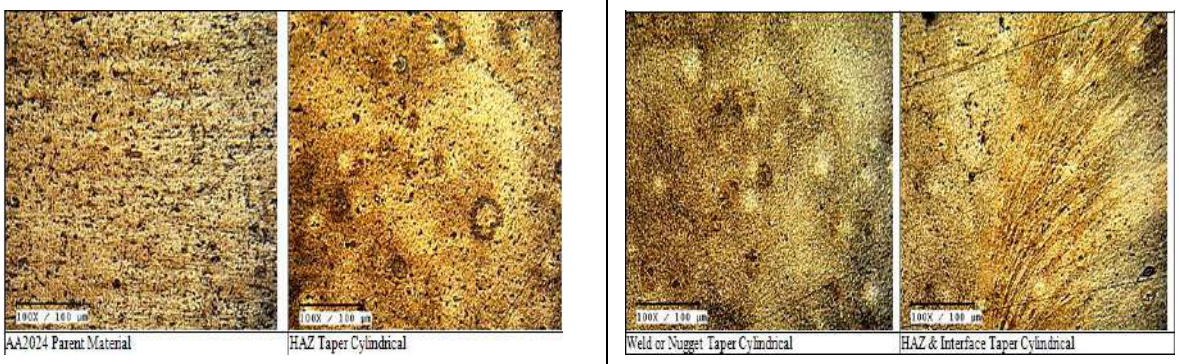


Figure 7: Microstructure of AA2024 by using Taper Cylindrical Profile

Magnification: 100X Etchant: H.F and Keller's Reagent

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RESEARCH ARTICLE

Impact of Biostimulant Foliar Nutrition on Yield Parameters of Carrot (*Daucus carota* L.) var. Early Nantes

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ABSTRACT

Carrot, an important root vegetable belonging to the family Umbelliferae is grown all over the world during both summer and winter seasons. Biostimulants is garnering importance and is also an area of study gaining attention by researchers all over the world in recent years. This present investigation was conducted during 2017 to 2018 on carrot variety 'Early nantes' in red laterite soil at Kethorai village, Coonoor, The Nilgiris district of Tamil Nadu, to study the effect of biostimulant foliar nutrition on yield of carrot. The experiment was laid out in randomized block design (RBD) with ten treatments, replicated thrice. The treatment includes various sources of biostimulants *viz.* Humic acid, Chitosan, Sea weed extract, Effective microorganisms and Panchagavya were given as foliar application on three stages *viz.*, first spray on 2 leaves stage, second spray on 5-7 leaves stage and third spray on when root attains 5-6 diameters in size. The various yield characters were recorded. The results of the experiment revealed that the yield parameters *viz.*, length of root, root diameter, root weight, root dry weight, root yield plot^{-1} and total root yield ha^{-1} were favorably influenced by foliar application of sea weed extract at a concentration of 3 ml per litre.

Keywords: Carrot, Biostimulants, SWE, Foliar spray, Yield.

INTRODUCTION

Vegetables are rich source of minerals and vitamins for human diet and are considered as protective foods. With increasing population there is an increasing demand of vegetables throughout the world urging a great necessity for increasing the production of vegetables. Carrot (*Daucus carota* L.) is one of the most important root vegetables and it belongs to the family Umbelliferae. It is an important vegetable crop grown all over the world during summer and winter in temperate regions and during winter in tropical and sub-tropical regions. The major carrot growing states

in India are Haryana, Punjab, Uttar Pradesh, Karnataka, Tamil Nadu and Andhra Pradesh. Haryana is the leading producer of carrot 372.13 tonnes with 27.80% share and in Tamil Nadu production is 140.95 tonnes with 10.53 % share. The total cultivable area under carrot in India is 24,000 ha with an annual production of 3.40 lakh tonnes (NHB, 2017).Carrot is used as a vegetable for soups, stews, curries, pies and grated roots are used as salad. Tender roots are used for making pickles and halwa. Carrot juice is also very popular and is the main source of carotene and is also used as colouring buffer in food preparation. Biostimulants stimulated endogenous plant defense response to both biotic and abiotic stress facters (Cambri *et al.,* 2008). The multiple functions of biostimulants have induced many researchers to investigate such effects on crops (Paradikovic *et al*., 2011). Sea weed extract or marine macroalgae are rich in diverse compounds like lipids, proteins, carbohydrates, phytohormones, amino acids, osmoprotectants, antimicrobial compounds minerals (Nati *et al*., 2016).

MATERIALS AND METHODS

The experiment on "Impact of Biostimulant Foliar Nutrition on Yield Parameters of Carrot (*Daucus carota* L.) var. Early Nantes" was carried out in the Kethorai village, Coonoor, The Nilgiri district of Tamilnadu. The experiment was carried out during 2017 - 2018. The treatment includes various sources of biostimulants *viz.* Humic acid, Chitosan, Sea weed extract, Effective microorganisms and Panchagavya were given as foliar application on three stages *viz.,* first spray on 2 leaves stage, second spray on 5-7 leaves stage and third spray on when root attains 5-6 diameters in size. The various yield characters were recorded. Carrot variety used in this experiment was 'Early Nantes'. It is a coreless, excellent variety for early and successional crops, producing uniform long smooth skinned blunt- ended roots. Observations on yield parameters *viz.,* length of root, root diameter, root weight, root dry weight, root yield plot^{-1} and total root yield ha^{-1} were recorded. The observations collected during the experiment in respect of crop were statistically analysed using the procedure given by Panse and Sukhatme (1978). The IRRISTAT software was used for the statistical analysis of the data.

RESULTS

Application of various biostimulants significantly influenced the yield parameters of carrot var. Early nantes (Table 1). The yield charactars *viz.,* length of root, root diameter, root weight, root dry weight, root yield plot^{-1} and total root yield ha^{-1} were significantly influenced by various treatments. The highest root length (22.16 cm), root diameter (3.41 cm), root weight (109.17 g plant $^{-1}$), root dry weight (11.55 g plant $^{-1}$), root yield plot^{-1} (14.55 kg) and total root yield ha^{-1}(27.29 t) were recorded the highest in the treatment T_5 which received sea weed extract @ 3 ml. The lowest root length (7.35 cm), root diameter (1.55 cm), root weight (60.32 g plant^{-1}), root dry weight (6.49 g plant^{-1}), root yield plot^{-1} (8.04 kg) and total root yield ha^{-1} (15.08 t) were recorded in the treatment T_{10} – control.

DISCUSSION

Sea weed extract was found to be superior because of high level of organic matter aids in retaining moisture and minerals in upper soil level available to roots. Sivasankari et al. (2006). Similar findings reported by Kumari et al. (2011) and Hernandez-Herrera et al. (2013) application of sea weed extract as foliar spray increased root length. This is could be due to the mineral nutrients present in sea weed extract. Yield and yield attributes increased by sea weed extract may be due to the presence of plant growth regulators (indole 3 acetic acid, gibberellins, kinetin and zeatin). Similar findings reported by Saravanan *et al*. (2003) and Haider et al. (2012) in potato plants treated with lower concentration of sea weed extract showed higher growth and yield. Improvement in growth may be due to the presence of certain growth promoting constitution and osmoprotectant betains in the extract. The possible reasons may include the bioactive components of sea weed extracts which at higher concentrations can inhibit plant growth. Similar findings was reported by Somasundaram et al., (2008) sea weed extract improved root system in tomato could be influenced by endogenous auxins as well as other compounds and sea weed is the opulent source of

secondary nutrients like magnesium. Uma Maheshwari (2017) also opined root diameter increased by application of sea weed extract might be due to accumulation of protein and carbohydrates.

CONCLUSION

Based on the present investigation, it can be concluded that foliar application of sea weed extract @ (3ml) can improve the yield attributing parameters which will ultimately results in increasing the productivity of carrot and it could be recommended to the farmers for obtaining higher yield and monetary return.

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Table 1.Effect of biostimulants on yield of carrot

S.No	Root length (cm)	Root diameter (cm)	Root weight (g plant^{-1})	Root dry weight (g)	Root yield (kg plot^{-1})	Total root yield (t ha^{-1})
T_1	8.98	2.05	67.97	7.82	9.06	16.99
T_2	8.71	1.80	63.98	7.16	8.53	15.99
T_3	18.41	3.14	99.80	10.91	13.30	24.95
T_4	10.25	2.61	79.05	9.37	10.53	19.76
T_5	22.16	3.41	109.17	11.55	14.55	27.29
T_6	10.93	2.64	81.07	9.60	10.80	20.26

T_7	10.01	2.31	71.63	8.45	9.55	17.90
T_8	14.64	2.89	90.44	10.26	12.05	22.61
T_9	10.09	2.35	72.96	8.73	9.72	18.24
T_{10}	7.35	1.55	60.32	6.49	8.04	15.08
S.Ed	1.85	0.12	4.67	0.30	0.62	-
CD (p=0.05)	3.70	0.24	9.35	0.61	1.24	-

Table2: Treatment details are given below

Treatments	
T_1	Humic acid (3%)
T_2	Humic acid (2%)
T_3	Chitosan (100ppm)
T_4	Chitosan (150ppm)
T_5	Sea weed extract (3ml / litre)
T_6	Sea weed extract (2ml / litre)
T_7	Effective microorganisms (1:1000)
T_8	Panchagavya (3%)
T_9	Panchagavya (5%)
T_{10}	Control

RESEARCH ARTICLE

An Investigation on Anticancerous Activity of the Cellar Spiders Web Extract against the Human Cervical Cancer Cell Line

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ABSTRACT

The Objective of the present study was the investigation of the anticancerous activity of the cellar spider web extract against the Human Cervical cancer cell line. The Cellar Spiders webs were collected and the Cellar spider web extract was prepared by dissolving it in a phosphate buffer. Then the prepared extract was analyzed in terms of anticancer activity against the Human Cervical Cancer cell lines (HeLa) by MTT assay. The MTT assay revealed formidable anticancer effects of the Cellar Spider web extract against the Human Cervical Cancer cell lines (HeLa). The Cell Viability was calculated from the absorbance at 570nm. The $IC_{50}$of the cellar spider web extract was calculated as 405.82 µg/ml by linear regression. Thus, the present study concludes that the Cellar Spider web extract exhibit Anticancer properties and this extract can be developed into an anticancer agent.

Keywords: Cellar Spiders, Spider Web, MTT assay, Cytotoxicity, Anticancer activity, Natural compound, Cervical cancer.

INTRODUCTION

Cancer is steadily being recognized as one of the major causes of the death of adults in the world [1]. Cervical cancer is the fourth most common kind of cancer in the world [2]. Cervical cancer is a public health problem in India. One-fourth of the worldwide burden of cervical cancers is reported from India. One in fifty-three of Indian women are likely to be affected by Cervical cancer while in other developed countries the ratio is approximately one in hundred

[3]. If the hereditary influence of cancer is low and the environmental factors in modifiable nature may result in the preventability of cancer. The prominent lifestyle factors that play a vital role in the incidence and mortality of cancer are tobacco, alcohol, diet, obesity, infectious agents, environmental pollutants, and radiation [4].The access to health care facility of the women in rural areas is neglected due to socio-cultural, economic and environmental factors [5]. The National Health Interview Survey data reveals that the Asian women were most probably to be behind the schedule for screening in 2019 (31%). About 80% of the cervical cancer is diagnosed at a fairly advanced stage and around 80,000 deaths are reported in India annually [6]. The early detection of cervical cancer may ensure its complete cure. Anticancer activity is the action exhibited by natural and synthetic or biological and chemical products to reverse, suppress or prevent the growth of Cancer cells[7].The incidence of irreversible drug resistance by cancer cells is one of the chief problems while treating cancer by chemotherapy[8]. Thus, there is an emerging need for new chemotherapeutic agents. Cellar spiders are the spiders which inhabit cellars, caves, cracks in walls, underground holes, and other dark places. The web of the cellar spider is irregular, with no perceivable pattern[9].Natural spider silk is a natural protein biomaterial secreted by spider's silk glands. It is one of the best biodegradable materials produced in nature [10]. Therefore, the present study was carried out to study the anti-proliferative and anticancer efficacy of Cellar spider web extract on cervical cancer cell lines. In view of the above,

The present investigation was undertaken with the following objectives

➢ To investigate the anti-proliferative and anticancer effects of the Web extract of Cellar spiders on HeLa cell lines (cervical cancer)

➢ To determine the IC_{50} dose of the sample

MATERIALS AND METHODS

Collection of Samples

Study Area

The selected sample for the present study was collected from Ambedkar Nagar, Podanur Chettipalayam main road, Coimbatore district, Tamil Nadu, India and Nirmala College for Women, Coimbatore district, Tamil Nadu, India. The Sample was collected in the first week of December 2021. About 202.4 g of the sample was collected from the cellars of the selected locations.

Extract Preparation

The sample extract was prepared by dissolving 0.1 g of sample in 1ml of the phosphate buffer. This extract was incubated at 40 ^{0}C for 24hrs in the rpm of 60 – 70 in an orbital shaker.

After incubation the extract was centrifuged at 5000 rpm for 6 minutes and then it was used for further study[11].

Anticancer Activity of Cellar Spider Extract

***Invitro* Cytotoxicity Determination by MTT Method**

For the anticancer activity HeLa Cell Line was used to study the anticancer activity of the sample. The cell Line were procured from National Centre for Cell Science (NCCS), Pune, India and has been maintained further in Centre for Bioscience and Nano Science Research Laboratory Eachanari, Coimbatore, Tamil Nadu, India. After obtaining, the Cell Line was sub cultured on to DMEM (Dulbecco's Modified Eagle Medium) with the addition of Sodium carbonate, Glucose and BSA (10%). After adding all the chemicals in T flask, the cells were incubated in CO_2 incubator in the pH of 7 to 7.5, temperature 37°C, humidity 70-80% for 24-72 hours. After incubation the growth of the cell line was confirmed by viewing under inverted microscope and used for further study.

Cell Seedling In 96 Well Plate

For the MTT assay cells were again seeded in 96-well plates and allowed to adhere for 24 hours at 37°C in 5% CO_2 and 70-80% of humidity. Cell line with sample in different concentration (25 to 400µl), along with blank (dimethyl

sulfoxide, DMSO) and control (Cell Line) and Standard control with standard drug (Doxorubicin-12.5µg) was incubated for 24 hours. Then the inverted microscopy micrographs were recorded.

Cytotoxicity by MTT Method

After incubation the cells was washed with DMSO and trypsin. After washing, 20µl of MTT dye was added to each well. After slight mixing, the plates were incubated for 24hours at 37°C in CO_2 incubator. The reaction mixture was then carefully taken out and formazan crystals were solubilized by adding 100 ml of DMSO to each well and mixed thoroughly. After 24hours the absorbance of purple color was read at 570 nm using 96 well plate ELISA reader (Robonik, India). After taking the reading percentage of cell death were calculated. Cell Viability calculation. Cell viability was shown as a ratio of absorbance (A_{570} nm). The percentage of Cell Viability was calculated using the following formula.

$$\% \text{ Of Cell Viability} = \frac{\text{Mean Absorbance of the Sample} - \text{Blank}}{\text{Mean Absorbance of Untreated} - \text{Blank}} \times 100$$

Determination of IC_{50}

The IC_{50} of the cellar spider web extract was calculated by the Linear Regression method. The Concentration and the Cell viability are plotted as x and y and the data were fitted with a straight line (linear regression). IC_{50} value is then estimated using the fitted line, i.e.,

$Y = a * X + b$

where $IC_{50} = (50 - b)/a$.

RESULTS AND DISCUSSION

Anticancerous Activity of Cellar Spider Web Extract

In the present study the anticancerous effect of the cellar spider web extract on the human cervical cancer cell lines were tested by using MTT assay. The results of the present study are presented in Table 1, Figure 1 and Plate 1. Table 1 shows the cell viability percentage of the cellar spider web extract on the human cervical cancer cell lines. Plate 1 shows the Inverted microscopy micrographs. The rounded cells indicate the apoptotic blebs. The number of rounded cells increases with increase in the concentration of Cellar Spiders web extract. The Cellar Spider Web Extract was treated under several concentrations ranging from 25 µl, 50 µl, 100 µl, 200 µl and 400 µl against the cervical cancer cells (HeLa). The present study revealed that at the concentration of 25 µl (Plate 1A), 97.79% of the cells showed viability. At 50 µl (Plate1B), 91.67 % of the cells were in viable condition. At 100 µl (Plate 1C), the percentage of cells in viable condition was 82.52 %. At 200 µl (Plate 1D), the cell viability is about 68.07 %. And at 400 µl (Plate 1E) the cell viability is reduced to 54.32 %.The control (Plate 1G) showed 100% cell viability. The cell lines treated with standard drug Doxorubicin (Plate 1F) showed cell viability of 55.94%. Therefore, from the results it can be interpreted that as concentration increases the cell viability percentage was found to decrease. And thus, the activity was found to be dose dependent. The figure 1 shows the graphical representation of the percentage of cell viability.

IC_{50} of the Cellar Spider Web Extract

The IC_{50} (half- maximal inhibitory concentration) of the cellar spider web extract was calculated as 405.82 µg/ml. Hence from the present study the cellar spider web extract is seen to have anticancerous activity against human cervical cancer cell line. As per the study of Elrayess (2019), the natural product has been proven to have anticancer activity and natural product research is a vigorous tool to discover the novel biologically active 20 components with unique mechanism of action. This revived the interest in studying the anticancer activity using natural product like Cellar Spider Web extracts in the present study. According to the studies conducted by Susheela and Rosaline (2019), the wasp nest extracts can be developed into an anticancer formulation since the bio synthesized silver nanoparticles of paper wasp nest and mud wasp nest exhibited anticancerous effect. According to the investigation carried out by Ozkan and Doganlar (2019), the IC50 dose of the spider web extract was good and satisfying, when compared to many other natural products in the market which have anticancer effects. In the present study the IC50 (half-

maximal inhibitory concentration) of the cellar spider web extract was determined as 405.82µg/ml, which showed a good toxicity against the cancer cells.

A similar study, carried out by Achmad*et al.,* (2019) revealed that the greater the sample (ethyl acetate extract of ant nest) concentration, the smaller the number of viable cells. The studies of Choudhari *et al.,* (2013) showed that the viability of cancer cells significantly reduced after treatment with higher. Concentrations of ethanolic extract of propolis. The present study also revealed the same fact. From the Table 1, it is obvious that the cell viability decreases in high concentrations.

CONCLUSION

The main objective of the present study was to investigate the anticancerous effects of the cellar spider web extract against the cervical cancer cell. From the present study it was revealed that the cellar spider web extract has anticancerous effect. The percentage of cell viability is purely dose dependent. The cell viability of cervical cancer cells decreases with high level of cellar spider web extract concentration. Thus, more the cellar spider web concentration less the viability of cancer cells. It also exhibited good cytotoxicity. The IC_{50} (half- maximal inhibitory concentration) of the cellar spider web extract was calculated as 405.82 µg/ml. Thus, the result highlighted the significance of cellar spider web as an anticancer agent.

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Table 1: Table Showing the Percentage of Cell Viability

Sl. No	Concentration (µl)	Cell Viability (%)
1	Control	100.00
2	25	97.79
3	50	91.67
4	100	82.52
5	200	68.07
6	400	54.32
7	Doxorubicin Drug - 12.5µg	55.94

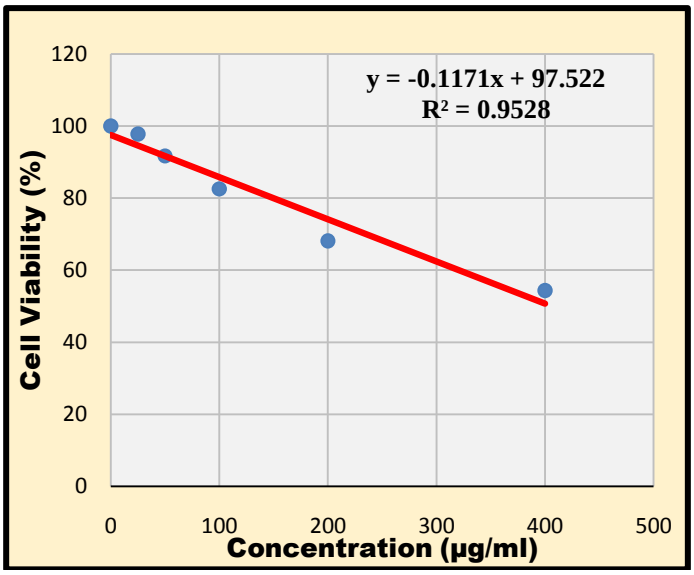
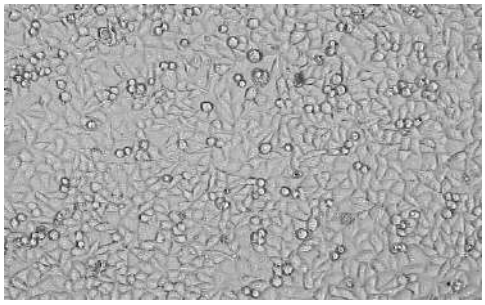
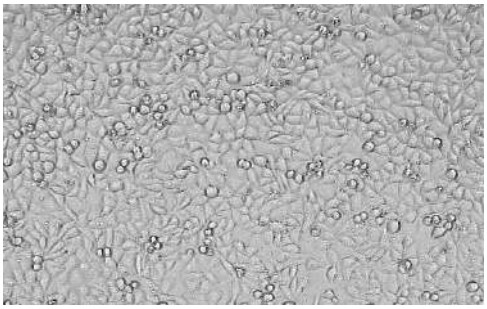


Figure 1: Graphical Representation of the Percentage of Cell Viability

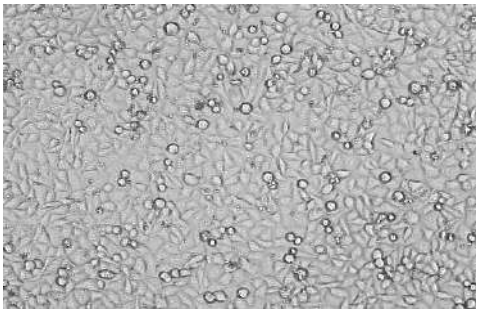
PLATE 1



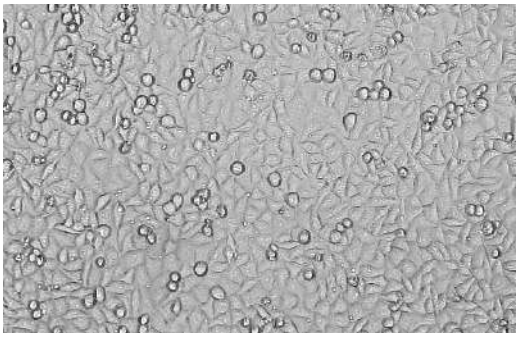
A) 25 µl



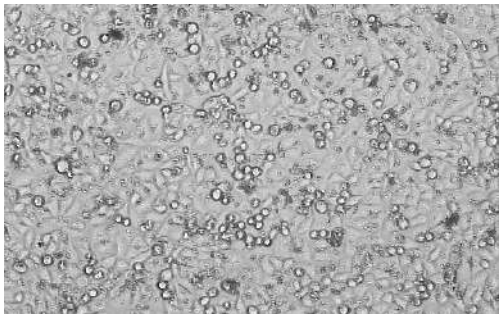
B) 50 µl



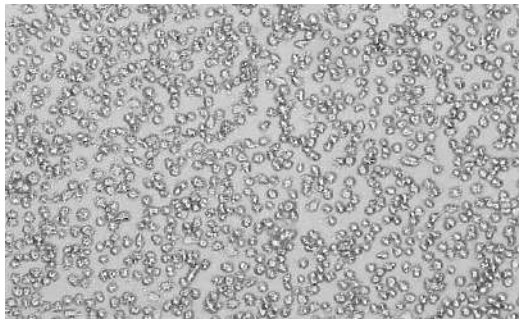
C) 100 µl



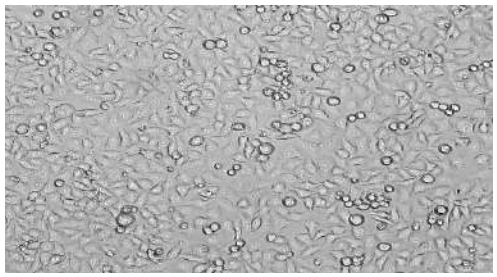
D) 200 µl



E) 400 µl



F) DOXORUBICIN DRUG



G) CONTROL *Inverted microscopy micrographs*

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RESEARCH ARTICLE

Influence of Liquid Formulations on Growth and Yield of Bhendi Var. *Arka anamika*

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ABSTRACT

Liquid biofertilizers are suspensions having agriculturally useful microorganisms, which fix atmospheric nitrogen and solubilize in soluble phosphates and make it available for the plant and directly reduces the use of chemical fertilizer by 15 to 40%. Biofertilizer consortia help the crops by providing nutrients, improving the growth hormone levels and as well as Induce Systemic Resistance (ISR)to control plant diseases in an efficient manner. The present study was conducted to formulate and determine the agriculturally important microbial consortium and tested on the growth and yield of Bhendi var. *Arkaanamika.* Based on the efficiency of the plant growth-promoting traits, *Azospirillum lipoferum*, *Bacillus megaterium* and *Pseudomonas fluorescens* were selected for inoculant production. The potculture experiment revealed that the treatment T_{10}(75%NPK+ *A. lipoferum*+ *B. megaterium*+ *P. fluorescens*) was found to be best in promoting the growth and yield of Bhendi followed by T_2(100% NPK).T_1(Control) were found to perform less. The results obtained from the study indicated a saving of more than 25 per cent of recommended NPK fertilizers by the application of the consortium of selected agriculturally important microorganisms to Bhendi.

Keywords: Liquid biofertilizer, Treatment, Microorganism, Bhendi

INTRODUCTION

Liquid biofertilizers are microbial suspensions that fix atmospheric nitrogen and solubilize insoluble phosphates, making them accessible to plants. The usage of this bio fertilizer is environmentally safe, produces consistent results for most agricultural crops, and decreases the use of chemical fertilizer by 15 to 40%. However, bio-fertilizer applications are increasing day by day because of their safe and environment-friendly nature. Bio-fertilizer is a potential source for plant nutrition and use of them are very efficient for organic and safe crop production (Uddin *et*

al., 2019). The uses of organic fertilizer have bio stimulating impact (Rakibuzzaman*et al.,* 2021a; Uddin *et al.,* 2020) increases plants vegetative growth (Rakibuzzaman*et al.,* 2019a) and yield suppress diseases, increase quality (Uddin *et al.,* 2021). Liquid biofertilizer has a longer shelf life than solid matrix-based bio fertilizer. The usage of these liquid bio fertilizers will aid Indian farmers in producing organic crops in order to compete in the global market. Organic foods are becoming more popular on the worldwide market. Okra is the most significant vegetable crop in the world's tropical and subtropical climates. India is the world's leading producer of 6.47 million tonnes are produced from a cultivable area of 5.28 million hectares, with a yield of 11.63 million tonnes per hectare (NHB 2019). *Azospirillum lipoferum, Bacillus megaterium,* and *Pseudomonas fluorescens* were widely recognized agriculturally helpful bioinoculants for their strong nitrogen fixing and plant growth stimulating properties. In general, carrier-based bioinoculants have a shorter shelf life, poor quality, high contamination, and poor field performance. Altering the rhizosphere microflora through seed, root, or soil inoculation with specific organisms has long been recognized as a practical possibility, but formulation deficits and a lack of good quality inoculums are frequently the most common barriers to bioinoculant commercialization and widespread adoption. The present study was undertaken to improve the growth and yield of Bhendi using different formulations of agriculturally important beneficial inoculants as single, dualand consortium. The experiments were conducted at the backyard of Department of Agricultural Microbiology, Faculty of Agriculture, Annamalai University, Annamalai Nagar with the following objectives Characterization of beneficial isolates of microorganisms and evaluation of comparative performance of liquid-based formulations of *Azospirillum, Phosphobacteria* and *Pseudomonas* isolates with graded levels of nitrogen, phosphorus and potassium on the growth, yield and quality of Bhendi.

MATERIALSANDMETHODS

A pot culture experiment was conducted during (July- September 2019) season in the potculture yard of the Department of Agricultural Microbiology, Faculty of Agriculture, Annamalai University, Annamalai Nagar. The annual mean minimum and maximum temperature of the pot culture yard is 25°C and 39°C, respectively and the mean highest and lowest relative humidity was 96 and 78 per cent respectively. The mean annual rainfall of this area is 1500 mm. The physico-chemical properties of the pot soil were analyzed, to study the effect of different formulations of bioinoculants as single, dual and consortium of agriculturally beneficial microbial isolates on plant growth and yield of Bhendi. The agriculturally beneficial microbial isolates of *A.lipoferum, B.megaterium,* and *P.fluorescens* were prepared as liquid-based single, dual and consortium of bioinoculants as described earlier and used in this study.

Preparation of pots and seed inoculation

The cement pots of size1'x2'x2' filled with land soil and sand in the ratio of 1:1. The seeds of Bhendivar. *Arkaanamika* was surface sterilized with 80 percent ethanol and 0.1 per cent mercuric chloride and washed the seeds with sterile distilled water for 3 to4 times. The seeds were mixed with carrier based agriculturally beneficial bio inoculants as single, dual and consortium of organisms separately having a cell load of $1x10^9$cfu ml^{-1} and shade dried for 30 min. After shade drying, the seeds weresownat25 seeds perpot and finally five seeds were maintained. A control pot with out inoculation was also maintained. The experiment was conducted in Completely randomized block design (CRD)design with three replications. The treatments are as follows.

Treatment details of the potculture experiment

T_1	:	Control
T_2	:	100%NPK
T_3	:	75%NPK
T_4	:	75%NPK+*A.lipoferum*
T_5	:	75%NPK+*B.megaterium*
T_6	:	75%NPK+*P.fluorescens*

T7 : 75%NPK+*A.lipoferum*+ *B.megaterium*
T8 : 75%NPK+*A.lipoferum*+ *P.fluorescens*
T9 : 75%NPK+ *B.megaterium*+*P.fluorescens*
T10 : 75%NPK+*A.lipoferum*+ *B.megaterium*+ *P.fluorescens*

Biometric observations viz., Plant height, Germination percentage, Vigour index, Plant dry matter production and fruit yield were recorded.

Growth attributes of bhendi

Plant height

Plant height was recorded from the ground level to the tip of terminal bud on 30,60 DAS and at harvest and expressed in cm.

Germination percentage

Germination percentage was computed by recording a total number of bhendi plants germinated against a number of seeds sown in each plot on the seventh day after sowing.

Vigour Index

Vigourindexwascomputedon15DASusingthefollowingproceduresuggestedby Abdul Balli and Anderson (1973). Vigour Index=Germination percentage × seedling height.

Dry matter production(DMP)

Five plants were removed at random from each treatment plot without damaging the roots and washed. The samples were sun dried initially for 24hrs and subsequently oven dried at 80ºC to attain a constant weight. Then,theDMPwasrecordedon30,60DASandatharvestandexpressedint/ha.

Fruit weight and yield

The harvested fruits were weighed at every stage until the final harvest and the mean fruit weight were recorded in grams. The total yield/ha was computed and recorded as tonnes / ha

RESULTS AND DISCUSSION

Authentication of *Azosprillum, Bacillus and Pseudomonas.* The microbial inoculants viz., *Azospirillum lipoferum, Bacillus megaterium* and *Pseudomonas fluorescens* used in the present study were obtained from the Department of Agricultural Microbiology, Faculty of Agriculture, Annamalai University. The number of *Azospirillum*, *Bacillus* and *Pseudomonas* were determined by the Most Probable Number (MPN) technique using NFB medium, and Nutrient agar medium after incubation for 2 weeks at 37°C.The effect of inoculation of liquid formulations of agriculturally important microorganisms on the seedling height, germination percentage, vigour index of Bhendi Var. *Arka anamika* was estimated and the results of the experiments are presented in Table 1. The ability of the microorganisms to fix the atmospheric nitrogen to the soil and made available to the growing plants. In addition to nitrogen fixation, *Azospirillum* is also responsible for the production of plant hormones like IAA, GA3 and cytokinins like substances which ultimately results in the better plant growth (Singh et al., 2010; Ramakrishnan and Selvakumar, 2012). The maximum seedling height, germination percentage and vigour indexwere observed inT8(*A.lipoferum*+*B. megaterium* + *P. fluorescens*) was on par with T6 (*A.lipoferum*+ *P. fluorescens*). Minimum was recorded in T1 uninoculated (control). The data regarding various growth and fruit characters has been presented in Table 2,3 & 4. Significantly the highest plant height 30 days (65.00 cm), 60 days(105.00 cm) days after sowing and at harvest (132.00 cm) was recorded with the treatment T10 followed by T2. The observations revealed that the differences in the dry matter yield of plant were significantly influenced by different biofertilizer treatments during the period of investigation. In this study dry matter production at 30DAS (1.50t/ha), 60DAS (12.39t/ha) and at harvest(15.55t/ha)T10 was on par with T2 (100% NPK) at 30 DAS (1.45 t/ha), 60 DAS (12.03 t/ha) and at harvest(15.06t/ha) has been presented in Table 3. Bio fertilizer

plays an important role in transporting of available nutrient (N, P, K, Fe, Mg) from the soil into the plant through root system, promotes plant growth also enhance fruit size (Sajid et al., 2013). Plants only uptake essential nutrient and liquid bio-fertilizers enhances the Availability of NPK which boosts up crop yield (Din et al., 2007). Highest number of fruits per plant (257.32g) was recorded with treatment T10 (75% NPK+ *A.lipoferum* + *B.megaterium* +*P.fluorescens*) followed by T2. Highest yield (16.27t/ha) was recorded with treatment T10 followed by treatment T2(100% NPK) is (15.69 t/ha). Minimum fruit yield at harvest was recorded in T1 (control) 12.50 t/ha (Table 4). The increase in higher values of yield attributes might be due to the higher production of leaf, leaf area, and height of plant, branches, flowers and fruits produced per plant. Increased foliage might have resulted in production of more photosynthates enhancing the yield potential (Choudhary et al.,2015). The seedling height, germination percentage, vigour index, plant height (cm), dry matter production, average fruit yield per plant(g)and fruit yield at harvest(t/ha) was maximum in the treatment containing consortium followed by dual inoculation and single inoculation. The effect of agriculturally important microbial inoculants on the population dynamics of bacteria, fungi and actinomycetes in Bhendi rhizosphere was estimated and the results of the experiment are presented in Fig. 5.The maximum microbial populations recorded in T10 was on par with T8at 30 DAS, 60 DAS and at harvest. Minimum microbial population was recorded in the treatment T1 (control).

CONCLUSION

Biofertilizer application are increasing day by day because of their safe and ecofriendly nature. The use biofertilizer have bio stimulating impact, increases plant vegetative growth and yield, suppress diseases and increase quality. In this study, results indicated that a saving of more than 25% of recommended NPK fertilizers could be possible by advocating the consortium of agriculturally important microorganisms to Bhendi.

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Table1: Effect of inoculation of liquid formulations of agriculturally important microbial inoculants on the seedling height, Germination percentage and Vigourindex of Bhendivar. *Arkaanamika*

S. No	Treatments	Germination percentage%	Seedling height(cm)	Vigour index
1	T_1– Control	80.30	9.00	722.70
2	T_2-*A.lipoferum*	85.00	10.50	892.50
3	T_3- *B.megaterium*	84.00	9.50	798.00
4	T_4-*P.fluorescens*	84.30	10.00	843.00
5	T_5-*A.lipoferum+B.megaterium*	86.50	11.50	994.75
6	T_6-*A.lipoferum+P.fluorescens*	92.00	12.00	1104.00
7	T_7-*B. megaterium+P. fluorescens*	86.00	11.00	946.00
8	T_8-*A.lipoferum+ B. megaterium+ P. fluorescens*	93.00	12.50	1162.50
SEd		0.34	0.34	0.89
CD(P=0.05)		0.70	0.70	1.76

Table 2: Effect of inoculation of liquid formulations of agriculturally important microbial inoculants on the plant height (cm) of Bhendivar. *Arkaanamika*

S.No	Treatments	Plantheight(cm)		
		30DAS	60DAS	At Harvest
1	T_1– Control	45.00	80.00	104.00
2	T_2-100%NPK	62.00	101.00	129.00
3	T_3-75%NPK	49.00	81.00	115.00
4	T_4-75%NPK+*A.lipoferum*	54.00	89.00	121.00
5	T_5-75% NPK+*B. megaterium*	52.00	85.00	117.00
6	T_6-75%NPK+*P.fluorescens*	52.00	85.00	117.00
7	T_7-75%NPK+ *A. lipoferum+B.megaterium*	60.00	96.00	127.00
8	T_8-75%NPK+ *A.lipoferum+P.fluorescens*	62.00	100.00	128.00
9	T_9-75%NPK+*B. megaterium+ P. fluorescens*	60.00	95.00	126.00
10	T_{10}- 75%NPK+*A.lipoferum+ B. megaterium+ P. fluorescens*	65.00	105.00	132.00
SEd		1.4	1..3	0.90
CD(P=0.05)		3.2	3.1	2.4

Table3: Effect of inoculation of liquid formulations of agriculturally important microbial inoculants on the Plant dry matter production (DMP) of Bhendi var. *Arkaanamika*

S.No	Treatments	Plant dry matter production(tha^{-1})		
		30DAS	60DAS	At Harvest
1	T_1– Control	1.02	7.36	9.23
2	T_2-100%NPK	1.45	12.03	15.06
3	T_3-75%NPK	1.14	10.12	13.10
4	T_4-75%NPK+ *A.lipoferum*	1.26	11.36	14.57
5	T_5-75% NPK+*B. megaterium*	1.16	10.56	13.51
6	T_6-75%NPK+*P.fluorescens*	1.17	11.00	13.96
7	T_7-75%NPK + *A. lipoferum+B. megaterium*	1.36	11.00	14.03
8	T_8-75%NPK+*A. lipoferum+P. fluorescens*	1.40	11.49	14.97
9	T_9-75%NPK+ *B. megaterium+ P. fluorescens*	1.30	10.97	13.79
10	T_{10}-75%NPK+*A.lipoferum+ B. megaterium+ P. fluorescens*	1.50	12.39	15.55
SEd		0.23	0.43	0.67
CD(P=0.05)		0.46	0.82	1.34

Table 4: Effect of inoculation of liquid formulations of agriculturally important microbial inoculants on Average yield perplant(g) and fruit yield(t/ha) of Bhendi var. *Arkaanamika*

S.No	Treatments	Averageyield/plant(g)	Fruit yield t/haAtharvest
1	T_1– Control	82.68	12.50
2	T_2-100%NPK	234.06	15.69
3	T_3-75%NPK	100.15	13.15
4	T_4-75%NPK+ *A.lipoferum*	158.37	13.95
5	T_5-75% NPK+*B. megaterium*	123.41	13.54
6	T_6-75%NPK+*P.fluorescens*	140.88	14.35
7	T_7-75%NPK+ *A.lipoferum+B. megaterium*	199.01	14.66
8	T_8-75%NPK+*A. lipoferum+P. fluorescens*	216.57	15.25
9	T_9-75%NPK+ *B. megaterium+ P. fluorescens*	181.61	14.80
10	T_{10}-75%NPK+*A.lipoferum+B. megaterium+ P. fluorescens*	257.32	16.27
SEd		5.81	1.43
CD(P=0.05)		17.45	2.67

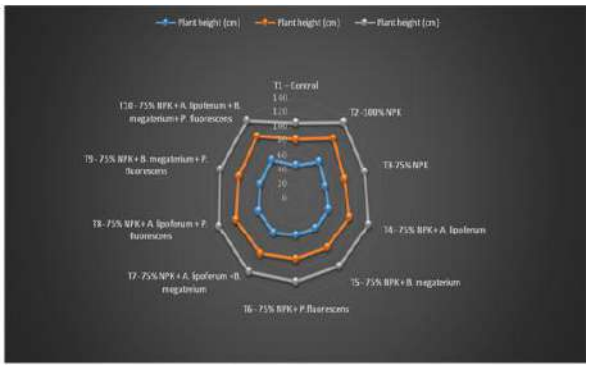

Figure 1:Effect of inoculation of liquid formulations of agriculturally important microbial inoculants on the plantheight(cm) of bhendivar.*Arkaanamika*

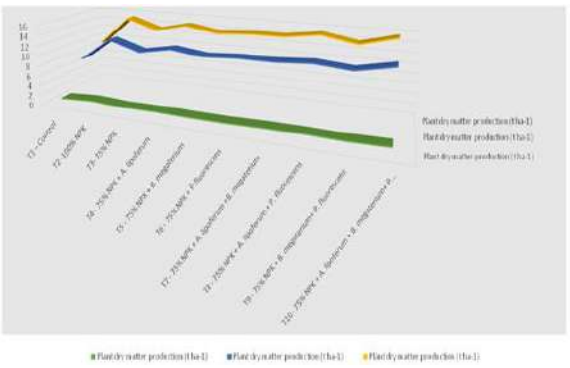

Figure 2: Effect of inoculation of liquid formulations of agriculturally important microbial inoculants on the Plantdrymatter production (DMP) of Bhendivar.*Arkaanamika*

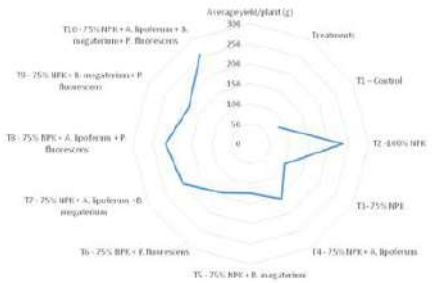

Figure 3: Effect of inoculation of liquid formulations of agriculturally important microbial inoculants on theAveragefruityield/plant(g)of Bhendivar. *Arkaanamika*

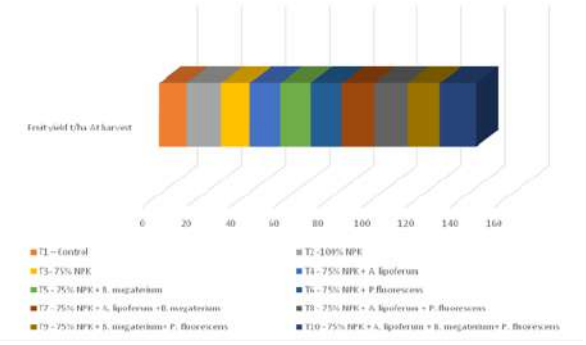

Figure 4: Effect of inoculation of liquid formulations of agriculturally important microbial inoculants on the fruityield(t/ha)of Bhendivar. *Arkaanamika*

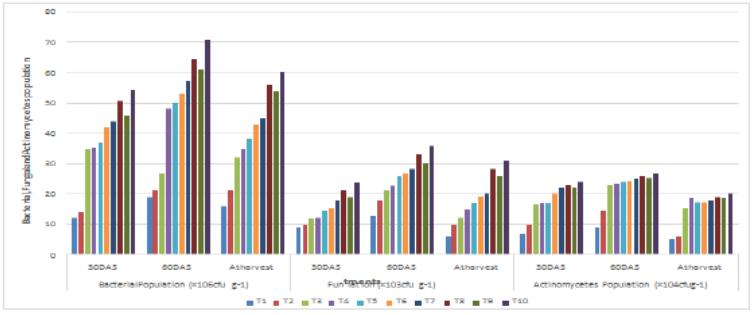

Figure 5: Effect of agriculturally important microbial inoculants on the population dynamics of Bacteria, Fungi and Actinomycetes in Bhendi rhizosphere

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RESEARCH ARTICLE

Connected and Compact Sets in ζ -Nano Topological Spaces

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ABSTRACT

This paper approaches the concept of ζ-connected and ζ-disconnected in $(V, \mathcal{T}_\zeta)$. We determined that there is a ζ-disconnected which has ζ-connected is subset. We learned the relationship occurs between ζ-disconnected (resp. ζ-connected) and $\mathcal{N}$-disconnected (resp. $\mathcal{N}$-connected). ζ_f is also represent ζ-connected in $(V, \mathcal{T}_\zeta)$.The concept of ζ-compact and ζ-compact relative are declare in $(V, \mathcal{T}_\zeta)$. Few of the results are deals between ζ- lindelöf and ζ-compact using ζ-compact relative.

Keywords: ζ-connected, ζ-disconnected, ζ-compact, ζ-compact relative and ζ- lindelöf space.

INTRODUCTION AND PRELIMINARIES

Lellis Thivagar and Carmel Richard [4] are constructed the concept Nano topological space. Krishnaprakash et al. [3] are involved in the concept of compact and connected in Nano -topology.The extension nano topology was ζ -nano topology are explained by Jenavee et al.[1].

Definition 1.1 [4] Let $\mathcal{V}$ be a non-empty finite set of members are called the universe and $\mathcal{R}$ has an equivalence relation on $\mathcal{V}$ known as the indiscernibility relation. Members belonging to the same equivalence class are called to be indiscernible with each other. The pair $(\mathcal{V}, \mathcal{R})$ is called to be the approximation-space. Let $\mathcal{X} \subset \mathcal{V}$.

1. The lower approximation of $\mathcal{X}$ with respect to $\mathcal{R}$ is the set of all members, which can be for certain classified as $\mathcal{X}$ with respect to $\mathcal{R}$ and it is represented by $\mathcal{L}_{\mathcal{R}}(\mathcal{X})$. That is,

$\mathcal{L}_{\mathcal{R}}(\mathcal{X}) = \cup_{x\in\mathcal{V}} \{\mathcal{R}(\mathcal{X}): \mathcal{R}(\mathcal{X}) \subseteq \mathcal{X}\}$,
where $\mathcal{R}(\mathcal{X})$ denoted the equivalence class determined by $\mathcal{X}$.

2. The upper approximation of $\mathcal{X}$ with respect to $\mathcal{R}$ is the set of all members, which can be possibly classified as $\mathcal{X}$ with respect to $\mathcal{R}$ and it is represented by $\mathcal{U}_{\mathcal{R}}(\mathcal{X})$.

(i.e.), $\mathcal{U}_{\mathcal{R}}(\mathcal{X}) = \cup_{x\in\mathcal{V}} \{\mathcal{R}(\mathcal{X}): \mathcal{R}(\mathcal{X}) \cap \mathcal{X} \neq \varphi\}$

3. The boundary region of $\mathcal{X}$ wit respect to $\mathcal{R}$ is the set of all members, which can be neither in nor as not-$\mathcal{X}$ with respect to $\mathcal{R}$ and it is represented by $\mathcal{B}_{\mathcal{R}}(\mathcal{X})$.

(i.e.), $\mathcal{B}_{\mathcal{R}}(\mathcal{X}) = \mathcal{U}_{\mathcal{R}}(\mathcal{X}) - \mathcal{L}_{\mathcal{R}}(\mathcal{X})$.

Definition 1.2 [4] Let $\mathcal{V}$ be the universe $\mathcal{R}$ be an equivalence relation on $\mathcal{V}$ and $\tau_{\mathcal{R}}(\mathcal{X}) = \{\mathcal{V}, \varphi, \mathcal{U}_{\mathrm{R}}(\mathrm{X}), \mathcal{L}_{\mathcal{R}}(\mathcal{X}), \mathcal{B}_{\mathcal{R}}(\mathcal{X})\}$, where $\mathcal{X} \subset \mathcal{V}$. Then $\tau_{\mathcal{R}}(\mathcal{X})$ satisfies the following axioms:

1. $\mathcal{V}$ and $\varphi \in \tau_{\mathcal{R}}(\mathcal{X})$.
2. The union of the members of any sub-collection of $\tau_{\mathcal{R}}(\mathcal{X})$ is in $\tau_{\mathcal{R}}(\mathcal{X})$.
3. The intersection of the members of finite sub-collection of $\tau_{\mathcal{R}}(\mathcal{X})$ is in $\tau_{\mathcal{R}}(\mathcal{X})$. That is, $\tau_{\mathcal{R}}(\mathcal{X})$ is a topology on $\mathcal{V}$ is called the Nano topology on $\mathcal{V}$ with respect to $\mathcal{X}$. $(\mathcal{V}, \tau_{\mathcal{R}}(\mathcal{X}))$ is called the Nano topological space. Members of the Nano topology are called Nano open sets in $\mathcal{V}$. Members of $[\tau_{\mathcal{R}}(\mathcal{X})]^{c}$ are called Nano closed sets.

Definition 1.3 [3] A nano topology $(\mathrm{V}, \tau_{\mathcal{N}})$ is said to be nano - connected if $(\mathrm{V}, \tau_{\mathcal{N}})$ cannot be expressed as union of two non-empty nano -open sets are disjoint. A subset of $(\mathrm{V}, \tau_{\mathcal{N}})$ is nano -connected as a subspace. A subset is said to be nano -disconnected if and only if it is not nano -connected.

Definition 1.4 [1] A subset J of a Nano topological space $(\mathrm{V}, \mathcal{N}_{\mathcal{R}})$ is called ζ -Nano-open set if there exists a Nano open set $\mathrm{Z} \in \mathcal{N}_{\mathcal{R}}$-O, such that

1. $\mathrm{Z} \neq \varphi, \mathrm{V}$.
2. $\mathrm{J} \subseteq \mathcal{N}_{\mathcal{R}}$-int(J) $\cup$ Z.

In $(\mathrm{V}, \mathcal{N}_{\mathcal{R}})$, the member of the open set is said to be ζ -Nano-open and the complement is ζ -Nano-closed set. The collection of all ζ-Nano-open including φ, V is said to be ζ -Nano-topological space if satisfies topological space definition. So, this $(\mathrm{V}, \mathcal{N}_{\mathcal{R}}, \zeta)$ or $\mathcal{N}$ -τ_{ζ}(J) can be rewritten in the form ζ -Nano-topological space on V.

Definition 1.5 [1] Let E be a subset of a ζ -Nano-Topology.

1. The union of all Nano-ζ sets contained in E is represent in the form of ζ -Nano-int(E). We can rewrite in the form $\zeta_{\mathcal{N}}$-i-(E).
2. The intersection of all Nano-ζ sets containing in E is represent in the form of ζ-Nano-cl(E). Also we write in the form $\zeta_{\mathcal{N}}$-c-(E).
3. The exterior of ζ-Nano-Topology in E is defined by $\zeta_{\mathcal{N}}$-e-(E) $= \zeta_{\mathcal{N}}$-i-(V − E).
4. The frontier of ζ-Nano-Topology in E is defined by $\zeta_{\mathcal{N}}$-f-(E) $= \zeta_{\mathcal{N}}$-c-(E) $\cap$ $\zeta_{\mathcal{N}}$-c-(V − E).

Proposition 1.6 [1]In $(\mathrm{V}, \mathcal{N}_{\mathcal{R}}, \zeta)$, if E and F are subsets, then the following should be attained.

1. $\zeta_{\mathcal{N}}$-i-(φ) = φ and $\zeta_{\mathcal{N}}$-c-(φ) = φ.
2. $\zeta_{\mathcal{N}}$-i-(V) = V and $\zeta_{\mathcal{N}}$-c-(V) = V.
3. $\zeta_{\mathcal{N}}$-i-(E) $\subseteq$ E $\subseteq$ $\zeta_{\mathcal{N}}$-c-(E).
4. E $\subseteq$ F $\Rightarrow$ $\zeta_{\mathcal{N}}$-i-(E) $\subseteq$ $\zeta_{\mathcal{N}}$-i-(F) and $\zeta_{\mathcal{N}}$-c-(E) $\subseteq$ $\zeta_{\mathcal{N}}$-i-(F).

5. $\zeta_{\mathcal{N}}$-i-(E ∩ F) ⊆ $\zeta_{\mathcal{N}}$-i-(E) ∩ $\zeta_{\mathcal{N}}$-i-(F).
6. $\zeta_{\mathcal{N}}$-c-(E ∩ F) = $\zeta_{\mathcal{N}}$-c-(E) ∩ $\zeta_{\mathcal{N}}$-c-(F).
7. $\zeta_{\mathcal{N}}$-c-(E ∪ F) ⊇ $\zeta_{\mathcal{N}}$-c-(E) ∪ $\zeta_{\mathcal{N}}$-c-(F).
8. $\zeta_{\mathcal{N}}$-i-(E ∪ F) = $\zeta_{\mathcal{N}}$-i-(E) ∪ $\zeta_{\mathcal{N}}$-i-(F).
9. $\zeta_{\mathcal{N}}$-i-($\zeta_{\mathcal{N}}$-i-(E)) ⊆ $\zeta_{\mathcal{N}}$-i-(E).
10. $\zeta_{\mathcal{N}}$-c-($\zeta_{\mathcal{N}}$-c-(E)) ⊇ $\zeta_{\mathcal{N}}$-c-(E).
11. $\zeta_{\mathcal{N}}$- i- (E) = E = $\zeta_{\mathcal{N}}$- c- (E).

Theorem 1.7 In $(V, \mathcal{N}_{\mathcal{R}}, \zeta)$,[1] for any subset E ⊆ V, V − $\zeta_{\mathcal{N}}$-i-(E) = $\zeta_{\mathcal{N}}$-c-(V − E).

Corollary 1.8 [1] V − $\zeta_{\mathcal{N}}$-c-(E) = $\zeta_{\mathcal{N}}$-i-(V − E).

Theorem 1.9 In (V, τ_{ζ}), [2] Z is ζ-closed set iff Z = ζ-closure set.

Corollary 1.10 In (V, τ_{ζ}),[2] Z is ζ-open set iff Z = ζ-interior set.

The content of the paper is shown: In section 2, We learn the idea of ζconnected and ζ-disconnected in ζ -nano topology space. We approach that there is a ζ-disconnected which has ζconnected is subset. We discussed the relationship occurs between ζdisconnected (resp. ζ-connected) and $\mathcal{N}$ -disconnected (resp. $\mathcal{N}$ -connected). We determine some properties using ζ-connected. In section 3, We study the concept of ζ-compact and ζ-relative compact in ζ-nano topology space. Some of the results are deals between ζ- lindelöf and ζ-compact. Finally, the conclusion is set forth in section 3.

2 ζ - Connected sets

In this section, we studied ζ -connected sets in (V, τ_{ζ}). A few results are characterized with ζ-disconnected and ζ-connected sets.

Definition 2.1 A space V is said to be ζ-connected if ∄ a pair of W, X of non-empty disjoint of ζ-open subsets of V such that V = W ∪ X, otherwise it is called ζ-disconnected. That is (i.e), the pair (W, X) is ζ-disconnected of V.

Note: $\mathcal{T}_{\zeta}$ is a ζ-nano topology and $\mathcal{T}_{\mathcal{N}}$ is a Nano topology.

Example 2.2 1. Let $V = \{x_1, x_2, x_3\}, V/\mathcal{R} = \{\{x_1\}, \{x_2\}, \{x_3\}\}, W = \{x_1, x_2\}$ and $\tau_{\mathcal{N}}(W) = \{\varphi, V, \{x_1, x_2\}\}$. Then, $\zeta = \{x_1, x_2\} \Rightarrow \tau_{\zeta}(W) = \{\varphi, V, \{x_1\}, \{x_2\}, \{x_1, x_2\}\}$. Therefore, V is ζ -connected.
2. Suppose $V = \{x_1, x_2, x_3, x_4, x_5\}$ with $V/\mathcal{R} = \{\{x_1\}, \{x_2\}, \{x_3, x_4, x_5\}\}, W = \{x_1, x_2, x_3\} \subset V$. $T_{\mathcal{N}}(W) = \{\varphi, V, \{x_1, x_2\}, \{x_3, x_4, x_5\}\}$.And $\zeta = \{x_1, x_2\} \Rightarrow \tau_{\zeta}(W) = \{\varphi, V, \{x_1\}, \{x_2\}, \{x_1, x_2\}, \{x_3, x_4, x_5\}, \{x_1, x_3, x_4, x_5\}, \{x_2, x_3, x_4, x_5\}\}$. Thence, V is ζ-disconnected because $V = \{x_1, x_2\} \cup \{x_3, x_4, x_5\}$.

Definition 2.3 Let $(V, \mathcal{T}_{\zeta})$ be a ζ-nano topological space and Z be a subset of V. Then the family of ζ-open sets in Z is defined by ζ-O(Z) = {W ⊆ V: W = Z ∩ O where O is ζ-open in $(V, \mathcal{T}_{\zeta})$}. (i. e), W is ζ-open in Z ⇔ W = Z ∩ O and O is ζ -open in $(V, \mathcal{T}_{\zeta})$.

Theorem 2.4 Let V be a ζ -disconnected and Z be a ζ -connected subset of V. If (W, X) is a ζ-disconnected of V, then Z is contained in W or in X.

Proof.

Assume Z is neither in W nor in X. Since (W, X) is a ζ -disconnection of X, by definition 2.1, W and X are non-empty disjoint ζ-open sets in V such that V = W ∪ X. By definition 2.3, Z ∩ W and Z ∩ X are both non-empty ζ-open sets in Z.

So, we get $(Z \cap W) \cap (Z \cap X) = \varphi$ and $(Z \cap W) \cup (Z \cap X) = Z$. Then, $(Z \cap W, Z \cap X)$ is a ζ -disconnected of $Z \Rightarrow Z$ is ζ -disconnected. Using contradiction, it gives the result.

Theorem 2.5 Let V be a ζ-nano topological space and $\{V_\alpha\}$, where $\alpha \in \mathcal{I}$ is a ζ-connected subsets of V such that $V = \cup_{\alpha \in \mathcal{I}} V$ and $\cap_{\alpha \in \mathcal{I}} V \neq \varphi$. Then, V is ζ-connected.
Proof. Let V is ζ -disconnected and (W, X) is a ζ-disconnected of V. Since each $\{V_\alpha\}$ is ζ -connected, by theorem 2.4, $\{V_\alpha\} \subseteq W$ or $\{V_\alpha\} \subseteq X$. Since $\cap_{\alpha \in \mathcal{I}} V \neq \varphi$, all $\{V_\alpha\}$ are in W or in X. This says that $V \subseteq W$ or $V \subseteq X$. If $V \subseteq W$, then $X = \varphi$ or if $V \subseteq X$, then $W = \varphi$. Using contradiction, it gives V is ζ-connected.

Theorem 2.6 Every ζ-disconnected of $(V, \mathcal{T}_\zeta) \Leftrightarrow (V, \mathcal{T}_\mathcal{N})$ is $\mathcal{N}$-disconnected.
Proof. Assume V is ζ-disconnected and $\zeta \in W \subseteq V$. Then, $\exists$ a pair of ζ-open sets W, X of non-empty disjoint V such that $V = W \cup X = ((\mathcal{N}\text{-int}(W) \cup \zeta) \cup (\mathcal{N}\text{-int}(X) \cup \zeta)) \subseteq (\mathcal{N}\text{-int}(W) \cup \mathcal{N}\text{-int}(X))$, by our assumption. Thus, $\mathcal{T}_\mathcal{N}$ of V is $\mathcal{N}$ -disconnected. Let V is $\mathcal{N}$-disconnected. So, $\exists$ a pair of $\mathcal{N}$-open sets W, X of non-empty disjoint V such that $V = W \cup X = (\mathcal{N}\text{-int}(W) \cup \mathcal{N}\text{-int}(X)) \subseteq ((\mathcal{N}\text{-int}(W) \cup \zeta) \cup (\mathcal{N}\text{-int}(X) \cup \zeta))$, by the definition $\mathcal{T}_\zeta$: $W = \zeta$ or $X = \zeta$. Hence, $\mathcal{T}_\zeta$ of V is ζ-disconnected.

Corollary 2.7 Every ζ-connected of $(V, \mathcal{T}_\zeta) \Leftrightarrow (V, \mathcal{T}_\mathcal{N})$ is $\mathcal{N}$-connected.
Proof. To prove that V is ζ-connected $\Rightarrow$ V is $\mathcal{N}$-connected. Let V is ζ-disconnected. By the theorem 2.6, V is $\mathcal{N}$-disconnected. Using contradiction, V is $\mathcal{N}$-connected. Similarly, the converse part is proved.

Theorem 2.8 In space V, is ζ-connected if and only if (iff) the only two subsets of V which are both ζ-open and ζ-closed are the sets V and φ.
Proof. Assume V is ζ-connected. Let Z be both ζ-open and ζ-closed subsets of V. Then, $V - Z$ is both ζ-open and ζ-closed. Since, V is disjoint union of ζ -open sets Z and $V - Z$, by our assumption either $Z = \varphi$ and $V - Z = V$ or $Z = V$ and $V - Z = \varphi$. Thence, if V is ζ-connected, then V has two subsets V and φ are both ζ-open and ζ-closed. $\Leftarrow$ (Conversely), suppose only the two subsets of V are both ζ-open and ζ-closed are the sets V and φ. If V is ζ-disconnected, then by the definition 2.1, $\exists$ a non-empty of disjoint pair of ζ-open sets W and X in V such that $V = W \cup X$. Since $X = V - W$ is ζ-open, W is both ζ-open and ζ-closed. By hypothesis, $W = \varphi$ or $W = V \Rightarrow X = V$ or $X = \varphi$. This contradiction gives V is ζ-connected.

Theorem 2.9 A space V is ζ-connected iff if every non-empty subsets of V has non-empty subsets of ζ-frontier.
Proof. Assume V is ζ-connected and $Z \subset V$. let $\zeta_f(Z) = \varphi$. Then, $\zeta_c(Z) \cap \zeta_c(V - Z) = \varphi \Rightarrow \zeta_c(E) \subseteq V - \zeta_c(V - Z)$, from definition 1.5(4). By using corollary 1.8, it gives $\zeta_c(Z) \subseteq \zeta_i(Z)$. Since $\zeta_i(Z) \subseteq Z \subseteq \zeta_c$, $\zeta_i(Z) = Z = \zeta_c$ and so by corollary 1.10 and theorem 1.9, Z is both ζ -open and ζ -closed. By applying Theorem 2.8, V is ζ-disconnected. Now using contradiction, it says that Z has a non-empty ζ_f. $\Leftarrow$, let every non-empty proper subset of V has a non-empty ζ_f. If V is ζ -disconnected, then by definition 2.1, $\exists$ non - empty disjoint ζ-open sets W and X in V such that $V = W \cup X$. Since $X = V - W$ is ζ-open, W is both ζ-open and ζ-closed. By using corollary 1.10, $W = \zeta_i(W)$ and by theorem 1.9, $W = \zeta_c(W)$. From the definition 1.5 and theorem 1.7, $\zeta_f(W) = \zeta_c(W) \cap \zeta_c(V - W) = W \cap (V - \zeta_i(W)) = W \cap (V - W) = \text{phi} \Rightarrow \zeta_f(W) = \varphi$. This contradiction gives that V is ζ-connected.

3 ζ -Compact Set

In this section, we learn ζ-compact and ζ- lindel*ö*f space. Some of the results are discussed with ζ-compact and ζ-lindel*ö*f space.

Definition 3.1 A space V is said to be ζ-compact if every ζ-open cover of V has a finite sub-cover.

Definition 3.2 A subset Z of a space V is said to be ζ-compact relative to V if for every cover $\{W_\alpha : \alpha \in \mathcal{I}\}$ of Z by ζ-open subsets of V, $\exists$ a finite subset $\mathcal{I}_f$ of $\mathcal{I}$ such that $Z \subseteq \cup \{W_i : i \in \mathcal{I}_f\}$.

Theorem 3.3 A space V is ζ-compact ⇔ for every class $\{Z_\alpha : \alpha \in \mathcal{I}\}$ of ζ-closed sets with finite intersection property, $\cap_{\alpha\in\mathcal{I}} Z_\alpha \neq \varphi$.

Proof. Let V is a ζ-compact space. Suppose $\{Z_\alpha : \alpha \in \mathcal{I}\}$ be a family of ζ-closed subsets of V with finite intersection property such that $\cap_{\alpha\in\mathcal{I}} Z_\alpha \neq \varphi$.Assume that ζ-open sets $W_\alpha = V - Z_\alpha$. Then, $\cup \{W_\alpha : \alpha \in \mathcal{I}\} = \cup \{V - Z_\alpha : \alpha \in \mathcal{I}\} = V - \cap \{Z_\alpha : \alpha \in \mathcal{I}\} = V - \varphi = V$. Hence $\{W_\alpha : \alpha \in \mathcal{I}\}$ is a ζ-open cover of V. Since V is ζ-compact, by definition 3.1, it has a finite subcover $\{U_{\alpha_i} : \alpha_i \in \mathcal{I}_f\}$. So, $V = \cup \{W_{\alpha_i} : \alpha_i \in \mathcal{I}_f\} = \cup \{V\ Z_{\alpha_i} : \alpha_i \in \mathcal{I}_f\} = V - \cap \{Z_{\alpha_i} : \alpha_i \in \mathcal{I}_f\} \Rightarrow \cap \{Z_{\alpha_i} : \alpha_i \in \mathcal{I}_f\} = \varphi$. By contradiction, $\cap \{Z_\alpha : \alpha \in \mathcal{I}_f\}$ gives finite intersection property. Thus, if the class $\cap \{Z_\alpha : \alpha \in \mathcal{I}_f\}$ of ζ -closed sets with finite intersection property, then $\cap_{\alpha\in\mathcal{I}_f} Z_\alpha \neq \varphi$. Conversely, a for assume every class $\{Z_\alpha : \alpha \in \mathcal{I}\}$ of ζ-closed sets with finite intersection property, $\cap_{\alpha\in\mathcal{I}} Z_\alpha \neq \varphi$. Assume $\{W_\alpha : \alpha \in \mathcal{I}\}$ be a ζ-open cover of V. Then, $X = \cup \{W_\alpha : \alpha \in \mathcal{I}\}$ and $\varphi = V - (\cup \{W_\alpha : \alpha \in \mathcal{I}\}) = \cap \{V - W_\alpha : \alpha \in \mathcal{I}\} \Rightarrow \{V - W_\alpha : \alpha \in \mathcal{I}\}$ is a class of ζ-closed sets with φ intersection. By assumption, ∃ a finite subset $\{V - W_{\alpha_i} : \alpha_i \in \mathcal{I}_f\}$ such that $\cap \{V - W_{\alpha_i} : \alpha_i \in \mathcal{I}_f\} = \varphi$. Then we have $V = V - \left(\cap \{V - W_{\alpha_i} : \alpha_i \in \mathcal{I}_f\}\right) \Rightarrow V = \cup \{V - (V - W_{\alpha_i}) : \alpha_i \in \mathcal{I}_f\} \Rightarrow V = \cup \{W_{\alpha_i} : \alpha_i \in \mathcal{I}_f\}$. Hence, $W_{\alpha_i}) : \alpha_i \in \mathcal{I}_f$ is a finite sub-cover of V. Thus, V is ζ-compact.

Theorem 3.4 A space V is ζ-compact iff each proper ζ-closed subset of V is ζ-compact relative to V.

Proof. Suppose V is a ζ-compact space. Let Z be any proper ζ-closed subset of V. So, $V - Z$ is ζ-open in V. Let $\{W_\alpha : \alpha \in \mathcal{I}\}$ is a ζ-open cover of Z. Then, $\{W_\alpha : \alpha \in \mathcal{I} \cup (V - Z)\}$ is a ζ -open cover of V. Since V is ζ-compact, by definition 3.1, it has a finite sub-cover, (i. e) $W_1, W_2, \ldots, W_n$. Hence, we got a finite ζ-open sub-cover of Z and then by definition 3.2, Z is ζ-compact relative to V. ⇐, let every proper ζ-closed subset of V is ζ -compact relative to V. Assume $\{W_\alpha : \alpha \in \mathcal{I}\}$ be a ζ-open cover of V. So, $V = \cup \{W_\alpha : \alpha \in \mathcal{I}\}$. Suppose $\alpha_i \in \mathcal{I}$.Then, $V - W_{\alpha_i}$ is a proper ζ-closed subset of V and $V - W_{\alpha_i} \subseteq \cup \{W_\alpha : \alpha \in \mathcal{I} - \{\alpha_i\}\}$. Thus, $\{W_\alpha : \alpha \in \mathcal{I} - \{\alpha_i\}\}$ is a ζ-open cover of $V - W_{\alpha_i}$. From our assumption, ∃ a finite subset $\mathcal{I}_f$ of $\mathcal{I} - \{\alpha_i\}$ such that $V - W_{\alpha_i} \subseteq \{W_\alpha : \alpha \in \mathcal{I}_f\}$. Then, $V \subseteq \cup \{W_\alpha : \alpha \in \mathcal{I}_f \cup \{\alpha_i\}\}$. This gives V is ζ-compact.

Definition 3.5 A ζ -nano topological space (V, τ_ζ) is said to be ζ- lindelöf space if every ζ-open cover of $(V, \mathcal{T}_\zeta)$ has countable subcover.

Theorem 3.6 Every ζ-compact space is a ζ- lindelöf space.

Proof. Let $(V, \mathcal{T}_\zeta)$ be ζ-compact. Let $\{Z_i : i \in \mathcal{I}\}$ be a ζ-open cover of $(V, \mathcal{T}_\zeta)$. Then, $\{Z_i : i \in \mathcal{I}\}$ has a finite sub-cover $\{Z_i : i = 1,2,3,\ldots,n\}$, since $(V, \mathcal{T}_\zeta)$ is ζ-compact. Since every finite sub-cover gives a countable sub-cover ⇒ $\{Z_i : i = 1,2,3,\ldots,n\}$, is countable sub-cover of $\{Z_i : i \in \mathcal{I}\}$ for $(V, \mathcal{T}_\zeta)$. Thus, $(V, \mathcal{T}_\zeta)$ is ζ- lindelöf space.

Theorem 3.7 If $(V, \mathcal{T}_\zeta)$ is ζ- lindelöf and countably ζ-compact space, then $(V, \mathcal{T}_\zeta)$ is ζ-compact.

Proof. Assume $(V, \mathcal{T}_\zeta)$ is ζ- lindelöf and countably ζ-compact. Let $\{Z_i : i \in \mathcal{I}\}$ be a ζ-open cover of $(V, \mathcal{T}_\zeta)$. Since $(V, \mathcal{T}_\zeta)$ is ζ- lindelöf $\{Z_i : i \in \mathcal{I}\}$ has countable sub-cover $\{Z_{ni} : n \in N\}$ where N is Natural Number ⇒ countable sub-cover ⇒ subclass of $\{Z_i : i \in \mathcal{I}\}$ ⇒ is a countable ζ-open cover of $(V, \mathcal{T}_\zeta)$. Again, since $(V, \mathcal{T}_\zeta)$ is countably ζ-compact, $\{Z_{ni} : n \in N\}$ has a finite sub-cover $\{Z_{ki} : k = i, 2, \ldots, n\}$. Hence, $\{Z_{ki} : k = i, 2, \ldots, n\}$ a finite sub-cover of $\{Z_i : i \in \mathcal{I}\}$ for $(V, \mathcal{T}_\zeta)$. Thus, $(V, \mathcal{T}_\zeta)$ is ζ-compact space.

CONCLUSION

We can portrayed the idea with ζ-connected and ζ-disconnected which deals on ζ-nano topology. Future, We can extend into the idea of ζ-locally connected, ζ-hyper connected, ζ-supra connected, ζ-ultra connected etc. And also develop in another topology field micro topology, bi-nano topology, fuzzy nano topology, neutrosophic nano topology etc.

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RESEARCH ARTICLE

Estimation of Heterosis for Fruit Yield and its Component Characters in Bhendi under Coastal Saline Condition (*Abelmoschus esculentus* L.)

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ABSTRACT

The present investigation was carried out involving six parents *viz*., arka anamika (P_1), thanvi 66 (P_2), villupuram local (P_3), dhaanya (P_4), ankur 41 (P_5) and varsha uphar (P_6) to estimate the heterosis in association with fruit yield and its component traits in bhendi. The parents were mated in the half-diallel mating system. The resultant fifteen hybrids were evaluated for five characters *viz*., number of nodes per plant, number of fruits per plant, number of seeds per fruit, single fruit weight and fruit yield per plant. Based on standard heterosis of hybrids, the cross arka anamika x varsha uphar (P_1 x P_6) was adjudged as the best hybrid for most of the traits and it may prove as a good source for commercial exploitation of heterosis for most of the characters in bhendi.

Keywords: Bhendi, half diallel, heterosis, fruit yield

INTRODUCTION

In recent years, we are just experiencing a marginal surplus production in cereals leading to self-sufficiency. However, shortage in the production of vegetables has drawn the attention for increased cultivation of vegetables to provide food and nutritional security. Among the vegetables, India is one of the largest producers and consumers of bhendi in the world. It is popularly known as ladies finger or okra is one of the most important vegetable crop grown in tropical and subtropical regions of the world and it is native of tropical Africa. It is commercially grown in Indian states of Gujarat, Maharashtra, Andhra Pradesh, Karnataka, Kerala and Tamil Nadu. Bhendi (*Abelmoschus esculentus*

(L.) Moench) is an important member of the family Malvaceae with chromosome number 2n=130.The success of any breeding programme primarily depends upon the judicious choice of parents. Genetic information especially about the nature of combining ability is a pre-requisite in fixing the suitable parents for heterosis breeding programme. Combining ability of genotypes provides an useful genetic information regarding the selection of parents. Genetic constitution and divergence between the parents involved in hybridization determine the nature of gene action. It is therefore, necessary to assess the genetic potentialities of the parents in hybrid combinations through systematic studies in relation to general and specific combining ability, which are due to additive and non- additive gene actions respectively. In this direction half diallel analysis has proved as a very useful tool to workout combining ability of parents. The data was analysed as described by Hayman (1954a) and Griffing (1956). For the succession in a breeding programme, the method of parent selection for hybridization is considered as a basic factor. Of the various approaches, exploitation of heterosis is considered as one of the desirable and sustainable approach. Heterosis reveals the type of gene action involved and it helps in the selection of suitable breeding methodology and parameters, which are employed for crop improvement programme. Heterotic studies can also provide the basis for exploitation of valuable hybrid combinations and their commercial utilization in future breeding programs Chowdhury *et al*., (2010). Therefore in the present investigation the superiority of the hybrids were estimated over the mid-parent, better parent and standard parent to judge the potential of crosses to be exploited in hybrid breeding programs

MATERIALS AND METHODS

The present investigation was carried out at the Plant Breeding Farm, Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, Annamalainagar. The biological materials used for this study comprised of six parents *viz*., arka anamika (P_1), thanvi 66 (P_2), villupuram local (P_3), dhaanya (P_4), ankur 41 (P_5) and varsha uphar (P_6). Crosses in all possible combination were made through half diallel method. The seeds obtained from the crossing block were sown during August 2017 to raise the hybrids. Six parents and fifteen hybrids were raised in a randomized block design with three replications. The seeds of each entry were sown in a single row of 3m long ridges with a spacing of 45cm x 30cm and uniform population of 10 plants were maintained. A total of 21 ridges were formed in a plot size of 9.5m x 9m. Cultural and agronomic practices were followed as per the standard recommendation and need based plant protection measures were taken up to maintain healthy cropstand. The biometrical observations like days to first flowering, plant height at maturity, number of primary branches per plant, fruit length and fruit girth were taken. The mean of parents and F_1 hybrids were utilized for the estimation of heterosis. Relative heterosis (di) was estimated as per cent deviation of the F_1 from the mid parental value (MP). Heterobeltiosis (dii) was estimated as per cent increase or decrease of F_1 over better parent (BP). Standard heterosis (diii) for each character was expressed as per cent increase or decrease of F_1 over the standard variety (SV) (Fonseca and Patterson, 1968). The genotype arka anamika was used as standard variety to work out standard heterosis. The significance of heterosis was tested using the formula suggested by Wynne *et al*. (1970).

RESULTS AND DISCUSSION

Information on the magnitude of heterosis is pre-requisite in the development of the hybrids. A good hybrid should manifest high amount of heterosis for commercial exploitation. Relative heterosis is of limited importance, because, it is only the deviation of F_1 from mid-parental value (Grakh and Choudhary, 1985). Heterobeltiosis is a measure of hybrid vigour over the better parent. Swaminathan *et al*. (1972) and Bobby and Natarajan (1994) stressed with the need for computing standard heterosis for commercial exploitation for hybrids. Hence, for the evaluation of hybrids standard heterosis is to be given more importance rather than the other two. For number of nodes per plant, nine out of 15 hybrids recorded positive significant relative heterosis for this trait. It was maximum with thanvi 66 x villupuram local (P_2 x P_3) followed by villupuram local x dhaanya (P_3 x P_4) and arka anamika x varsha uphar (P_1 x P_6).

Five out of 15 hybrids registered negative significant heterobeltiosis for this trait. It was maximum with arka anamika x varsha uphar (P_1 x P_6) followed by thanvi 66 x villupuram local (P_2 x P_3) and thanvi 66 x dhaanya (P_2 x P_4). Six out of 15 hybrids exhibited positive significant standard heterosis for this trait. It was maximum with arka anamika x varsha uphar (P_1 x P_6) followed by thanvi 66 x villupuram local (P_2 x P_3) and thanvi 66 x dhaanya (P_2 x P_4). The observed direction and magnitude of standard heterosis for this trait added scope for inclusion of this trait in heterosis breeding programme. The result is in conformity with the findings of Jindal *et al*. (2009). For the trait number of fruits per plant, all 15 hybrids recorded positive significant relative heterosis for this trait. It was maximum with thanvi 66 x dhaanya (P_2 x P_4) followed by villupura local x dhaanya (P_3 x P_4) and thanvi 66 x ankur 41 (P_2 x P_5). Fourteen out of 15 hybrids registered negative significant heterobeltiosis for this trait. It was maximum with thanvi 66 x dhaanya (P_2 x P_4) followed by thanvi 66 x ankur 41 (P_2 x P_5) and villupuram local x dhaanya (P_3 x P_4). Nine out of 15 hybrids exhibited positive significant standard heterosis for this trait. It was maximum with arka anamika x varsha uphar (P_1 x P_6) followed by thanvi 66 x dhaanya (P_2 x P_4) and dhaanya x varsha uphar (P_4 x P_6). The observed direction and magnitude of standard heterosis for this trait added scope for inclusion of this trait in heterosis breeding programme. The result is in agreement with the findings of Sonia Sood and Pritam Kalia (2001) and Senthil Kumar *et al*. (2007b).

For the character number of seeds per fruit, eleven out of 15 hybrids recorded positive significant relative heterosis for this trait. It was maximum with arka anamika x thanvi 66 (P_1 x P_2) followed by thanvi 66 x dhaanya (P_2 x P_4) and thanvi 66 x villupuram local (P_2 x P_3). Five out of 15 hybrids registered negative significant heterobeltiosis for this trait. It was maximum with arka anamika x thanvi 66 (P_1 x P_2) followed by thanvi 66 x dhaanya (P_2 x P_4) and thanvi 66 x villupuram Local (P_2 x P_3). Fourteen out of 15 hybrids exhibited positive significant standard heterosis for this trait. It was maximum with thanvi 66 x dhaanya (P_2 x P_4) followed by arka anamika x thanvi 66 (P_1 x P_2) and dhaanya x varsha uphar (P_4 x P_6). The observed direction and magnitude of standard heterosis for this trait added scope for inclusion of this trait in heterosis breeding programme. The result is in corroboration with the findings of Dabandata *et al*. (2010). In single fruit weight, ten out of 15 hybrids recorded positive significant relative heterosis for this trait. It was maximum with thanvi 66 x dhaanya (P_2 x P_4) followed by villupuram local x dhaanya (P_3 x P_4) and arka anamika x varsha uphar (P_1 x P_6). Eight out of 15 hybrids registered negative significant heterobeltiosis for this trait. It was maximum with thanvi 66 x dhaanya (P_2 x P_4) followed by arka anamika x varsha uphar (P_1 x P_6) and thanvi 66 x ankur 41 (P_2 x P_5). Seven out of 15 hybrids exhibited positive significant standard heterosis for this trait. It was maximum with arka anamika x varsha uphar (P_1 x P_6) followed by thanvi 66 x dhaanya (P_2 x P_4) and dhaanya x varsha uphar (P_4 x P_6). The observed direction and magnitude of standard heterosis for this trait added scope for inclusion of this trait in heterosis breeding programme. The result is in agreement with the findings of Seema Pandey *et al*. (2008). For the character fruit yield per plant, twelve out of 15 hybrids recorded positive significant relative heterosis for this trait. It was maximum with thanvi 66 x dhaanya (P_2 x P_4) followed by villupuram local x dhaanya (P_3 x P_4) and thanvi 66 x ankur 41 (P_2 x P_5). Ten out of 15 hybrids registered negative significant heterobeltiosis for this trait. It was maximum with thanvi 66 x dhaanya (P_2 x P_4) followed by thanvi 66 x ankur 41 (P_2 x P_5) and arka anamika x varsha uphar (P_1 x P_6). Eight out of 15 hybrids exhibited positive significant standard heterosis for this trait. It was maximum with arka anamika x varsha uphar (P_1 x P_6) followed by thanvi 66 x dhaanya (P_2 x P_4) and dhaanya x varsha uphar (P_4 x P_6). The observed direction and magnitude of standard heterosis for this trait added scope for inclusion of this trait in heterosis breeding programme. The result is in agreement with the findings of Singh *et al*. (2009a).

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Table 1. Percentage of heterosis for fruit yield and its component characters

Characters	Number of nodes per plant			Number of fruits per plant			Number of seeds per fruit			Single fruit weight			Fruit yield per plant		
Hybrids	RH (di)	HB (dii)	SH (diii)	RH (di)	HB(dii)	SH(diii)	RH(di)	HB(dii)	SH(diii)	RH(di)	HB(dii)	SH(diii)	RH(di)	HB(dii)	SH(diii)
$P_1 \times P_2$	10.04**	9.61**	10.47**	20.90**	12.17**	12.17**	26.75**	20.89**	20.89**	10.72**	4.62**	4.62**	33.26**	17.36**	17.36**
$P_1 \times P_3$	9.54**	0.84 ns	0.84 ns	22.26**	8.38**	8.38**	3.12**	1.39**	1.39**	13.95**	2.11**	2.11**	37.28**	10.67**	10.67**
$P_1 \times P_4$	3.20 ns	2.91 ns	2.91 ns	9.52**	3.28**	3.28**	3.43**	-0.35**	7.51**	-0.44**	-2.34**	-2.34**	8.91**	0.87**	0.87**
$P_1 \times P_5$	-11.69**	-12.78**	-12.78**	15.00**	4.64**	4.64**	-2.51**	-9.66**	5.88**	3.51**	-4.97**	-4.97**	18.00**	-0.55**	-0.55**
$P_1 \times P_6$	14.45**	14.31**	14.60**	33.63**	29.16**	29.16**	3.02**	-2.81**	9.59**	25.18**	23.57**	23.57**	67.20**	59.61**	59.61**
$P_2 \times P_3$	20.65**	10.67**	11.54**	15.30**	9.73**	-6.12**	15.40**	11.89**	8.13**	7.84**	1.92**	-9.30**	23.98**	11.84**	-14.85**
$P_2 \times P_4$	10.38**	9.65**	10.51**	40.57**	38.15**	22.42**	26.12**	16.11**	25.27**	30.09**	25.22**	20.43**	82.74**	72.99**	47.44**
$P_2 \times P_5$	5.10**	3.41 ns	4.22*	36.13**	33.29**	14.04**	8.88**	-3.40**	13.22**	24.14**	20.40**	7.13**	68.88**	60.48**	22.18**
$P_2 \times P_6$	-1.07**	-1.34 ns	-0.56 ns	5.41**	1.03**	-5.72**	4.94**	-5.29**	6.80**	0.00 ns	-4.34**	-6.79**	5.21**	-3.35**	-12.12**
$P_3 \times P_4$	17.93**	8.84**	8.23**	40.55**	31.57**	16.59**	1.72**	-3.58**	4.02**	29.45**	18.04**	13.53**	80.75**	55.31**	32.37**
$P_3 \times P_5$	-0.42 ns	-7.27**	-9.55**	25.06**	21.48	-0.40**	2.05**	-6.90**	9.10**	2.21**	-0.48**	-16.78**	27.72**	20.90**	-17.11**
$P_3 \times P_6$	-1.88**	-9.78**	-9.55**	5.48**	-3.58**	-10.02**	-19.26**	-25.04**	-15.47**	-9.21**	-17.69**	-19.81**	-5.16**	-20.64**	-27.84**
$P_4 \times P_5$	-13.10**	-13.93**	-14.41**	13.31**	9.07**	-3.34**	-0.22**	-4.18**	12.30**	-13.33**	-18.99**	-22.09**	-2.07**	-11.64**	-24.69**
$P_4 \times P_6$	3.02**	2.61 ns	2.86 ns	31.15**	27.85**	19.31**	3.79**	1.55**	14.51**	20.70**	19.92**	16.84**	58.27**	53.32**	39.40**
$P_5 \times P_6$	3.43*	2.03 ns	2.29 ns	11.37**	4.61**	-2.38**	-8.65**	-10.38**	5.03**	-17.34**	-23.20**	-25.17**	-8.39**	-19.66**	-26.95**

*significant at 5% level RH- Relative Heterosis HB – Heterobeltiosis SH – Standard Heterosis
**significant at 1% level

RESEARCH ARTICLE

A Systematic Review on CKD Risk Prediction using Machine Learning Algorithm

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ABSTRACT

Chronic kidney disease is estimated that it affects 1 in every 10 adults in India. Thus, a pragmatic approach to reducing the global burden of renal and cardiovascular diseases has to be adopted. Conventional techniques to detect CKD are based on urine test, blood test, and biopsy. All these techniques are time consuming, costly and based on one or more tests for verification of the disease. Diagnosis of CKD is still inadequate at the clinical level and it is not possible to detect the CKD in early stage. Recently machine learning based approaches provides the efficient result in disease diagnosis. The present study retrospect's the recent researches related to the chronic kidney disease diagnostic using machine learning approaches. This research assists to analyze the drawbacks of the prior study and provides a path for most applicable detection system.

Keywords: Machine learning, classification, chronic kidney disease, Prediction

INTRODUCTION

Human health can be affected by various diseases. Among them kidney disease plays a vital role. 10% of the population worldwide is affected by Chronic Kidney Disease (CKD) and over 2 million people all around the world are receiving treatment for dialysis or kidney transplantation, where dialysis or transplantation of kidney, is the final treatment given to a kidney patient, to survive. Millions of people die each year because of kidney disease [1]. Data mining provides a tool for decision making especially for individual patients this tool identifies valid, useful and understandable data and maintains a high confidential prediction for people, a standard statistical tool has is used for survival. Kidney disease is increasing, and its prevailing seeks public attention, the treatment can be an extraordinary cost for this illness and the negligence may lead to cardiovascular disease. CKD affects the kidney and

also causes damage to the kidney and fails to purify the blood. Kidneys functions decrease up to half its working efficiency it is said as the failure of chronic renal. The advanced stage of this is results in very severe malfunction of the kidney, in this case, the function of the organ is reduced a bit, and the only possibility for survival is either transplantation or dialysis of the kidney. Data mining technique is applied as a classifier in disease diagnosis using the prior dataset. Maintaining accuracy of the classifier is essential to obtain better performance in medical data diagnosis. The performance of the classification model depends on the operational procedure of it. Many classification approaches have been used for diagnosis such as ANN, DT, SVM, fuzzy, KNN, etc. The algorithms applied in the prior study has its own benefits and drawbacks. Still a proper model has to develop for disease diagnosis that can be able to applied in real world. For that a proper survey is essential to analyze the prior work related to renal failure prediction process. The contribution of this study is to survey the existing study and their limitation in order to develop a novel approach that enhance the performance of the classification and prediction.

Related works

N.Bhaskar and M.Suchetha [2] used the combination of convolutional neural network with support vector machine to develop an automated diagnosis system. The traditional CNN is enhanced with SVM in order to overcome the drawbacks of CNN. This model utilizes the salivary urea as potential biomarker for CKD diagnosis. Indian patient data is collected for this research experiments. The detection system is evaluated with all possible performance metrics and achieved 98.67% accuracy. Qin et al [3]adopted the machine learning algorithm to discover the CKD using the samples collected from UCI repository. The data in UCI contains large missing value and processed with KNN. The authors used best performing six ML approaches and evaluated this model and integrate the logistic regression and random forest with perceptron for disease diagnosis. The model with KNN and combine LR with RF achieved 99.83% accuracy. Ahmed Abdelaziz *et al* [4] introduced an approach for diagnosing and predicting the disease anywhere through cloud computing. The LR and NN algorithm is utilized for critical factor analysis and prediction respectively. Windows azure is accessed for cloud environment and the present model achieved 97.8% accuracy.

Based on the model a case study is performed with three different patient data. Jain, Divya, and Vijendra Singh [5] in this examination, a quick, novel versatile classification system is displayed for the conclusion of chronic diseases. For this reason, the proposed methodology utilizes a hybrid methodology involving PCA and Relief technique with enhanced Support Vector Machine classifier. Besra, *et.al* [6] in this original copy, we have proposed a system that will generate a prediction of CKD with higher precision esteem, trailed by the estimation of kidney harm rate. The fundamental goal of this analysis is to robotize a prediction system that will analyze the various stages in CKD. It begins with the prehandling steps, closes with the classification, recognizes the effectively characterized occasions, and then figures its GFR esteem. El-Houssainy *et al* [7] build up the classifier model with PNN, MLP, SVM and RBF machine learning algorithms for CKD stages prediction process. The dataset is collected from UCI repository which has 361 instances. The system achieved great performance of 96.7% accuracy when using PNN. This model attempts to predict the different stages of CKD. Jivanparab *et al* [8] the principle goal of this paper is to give an account of research where we exploited those accessible technological progressions to create prediction models for CKD prediction on diabetes patients, and furthermore the primary objective of restorative information mining systems is to get best calculations that depict given information from various perspectives. In this examination, three information mining methods (BP- ANN and PLSR) are utilized to inspire learning about the connection between these factors and patient endurance. The model is developed based on two factors like blood urea and glucose. The principle component analysis is further used to improve the accuracy of the model. Wang *et al* [9]introduced the multi-task deep and wide neural network classifier to discover the Renal failure prediction from heart patients.

The investigation depends on the EHR information containing right around too many years of clinical perceptions gathered at PLA General Hospital, a huge medical clinic in Beijing with one of the most established electronic health records in the china. The dataset is collected from Chinese hospital and start the prediction process with missing value elimination and normalization. Multi-task deep and wide neural network classifier(MT-DWNN) is then applied to diagnosis the renal failure which is illustrated in figure 1. The input layer and all the hidden layers are

shared layers, while the output layer is a specific layer for different tasks. The Roc and Auc is computed to evaluate the performance of this study. Bilal khan et al [10] explored the significance of early detection of CKD by applying the machine learning algorithms. The dataset is collected from UCI repository which is further preprocessed with missing value elimination. Then Composite Hypercube on Iterated Random Projection is utilized for classification and prediction. The performance is evaluated with all possible metrics such as RMSE, RRSE, precision, recall accuracy, etc., Alvaro Sobrinho *et al* [11]proposed a system that will generate a prediction of CKD with higher precision esteem, trailed by the estimation of kidney harm rate. The fundamental goal of this analysis is to robotize a prediction system through several machine learning algorithms. It begins with the prehandling steps, closes with the classification, recognizes the effectively characterized occasions, and then figures its CKD risk. Fuzhe Ma *et al* [12] applied Heterogeneous Modified Artificial Neural Network (HMANN) for CKD detection. This approach was evaluated using the image dataset. The data is preprocessed for speckling noise removal and segmentation is performed and applied HMANN classification. The present model was compared with traditional machine learning algorithms. This study achieved 98 % accuracy compared to others.

DISCUSSION

From the literature it is clear that most of the studies applied traditional machine learning algorithms. Few studies applied hybrid techniques and achieved great result. The Major approaches used machine learning algorithms such as SVM, J48, and LR and enhanced SVM. Some studies applied deep learning algorithm for CKD diagnosis and prediction. The accuracy obtained from the literature was represented in figure 2.The limitations presents in the literature, A proper feature selection were not applied, Only two models achieve the great result. However they don't analyze the error rates, Single dataset is used for performance evaluation which is not enough to test the model and only few study analyzed the error related performance. A novel system has to be developed to overcome the above issues. The feature must be known to have more weighted values based on the hybrid algorithm of Particle swarm optimization with squirrel search algorithm (PSO-SSA) that enhances the feature selection. Hybrid Artificial neural network is introduced to increase classification accuracy with less error rates and false positive rate. ANN is combined with grey wolf optimization to develop the efficient and fast data processing algorithms for automated classification of chronic kidney disease. Figure 1.3 illustrates the architecture of the proposed ckd prediction system. The dataset is collected from UCI repository and the missing data is processed in the preprocessing step. Then the features are selected with PSO-SSA approach. Significant features improve the overall performance of the classifier. Eventually the Hybrid ANN is applied for classification process and diagnosis the CKD.

CONCLUSION

The present study retrospect's the latest research on renal failure prediction using various machine learning and deep learning approaches. Most of the study was conducted with UCI repository dataset which is available in online. The performances were evaluated using the accuracy, precision, recall, specificity, sensitivity. Some studies analyze the error related performance metrics like RMSE, RRSE, and MAE. Among the several approach from the literature, Random forest and CHIRP was achieved the great result for diagnosis. A novel framework is proposed with feature selection and classification algorithms to enhance the detection process.

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Table 1: Comparison of various approaches on renal failure detection

	Authors	Year	Dataset	Method	Outcome (%)
1	N.Bhaskar and M.Suchetha [2]	2019	Samples collected from Kannur District Health Center India	CNN with SVM	Accuracy-98.67, Sensitivity- 98.41 Specificity- 99.01
2	Qin et al [3]	2019	UCI Repository	Random forest	Accuracy-99.75% Sensitivity- 99.84 Specificity- 99.80
3	Ahmed Abdelaziz et al [4]	2019	Real time Data collected through web page.	LR and NN	Accuracy-97.8%
4	Divya Jain &Vijendra Singh [5]	2019	UCI Repository	Adaptive SVM	Accuracy-97.48 Precision- 98.68 Recall- 98.04 F-measure- 97.40 Specificity- 97.62
5	Ankit et al [6]	2019	UCI Repository		
6	El-Houssainy et al [7]	2019	UCI Repository	PNN	Accuracy- 96.7
7	Wang at al [9]	2019	PLA General Hospital data	MT-DWNN	Sensitivity- 0.8748 AUC-0.9393
8	Jivanparab et al [8]	2020	Spectra of glucose recorded with Jasco	BP-ANN	blood urea accuracy-95.96

			V770.		glucose accuracy-98.65
9	Bilal khan et al [10]	2020	UCI Repository	CHIRP	Accuracy-99.75 Precision- 0.998 Recall- 0.998 F-measure- 0.998
10	Fuzhe Ma et al [11]	2020	UCI Repository	Heterogeneous Modified Artificial Neural Network	Accuracy-98.00
9	Alvaro Sobrinho et al[12]	2021	UCI Repository	J48	Accuracy-95.00
10	MD. Rashed-al-mahfuz [13]	2021	UCI Repository	RF	Accuracy-99.5 Sensitivity-98.78 Specificity-100

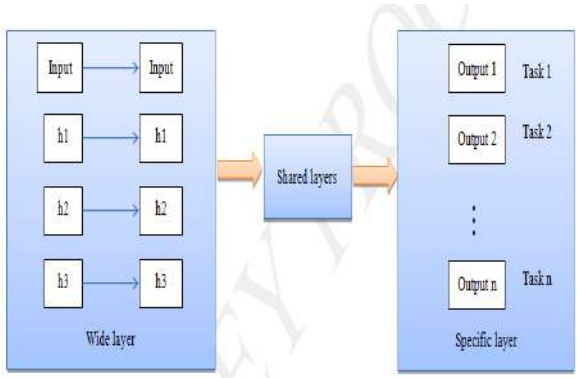

Figure 1.1Framework of MT-DWNN

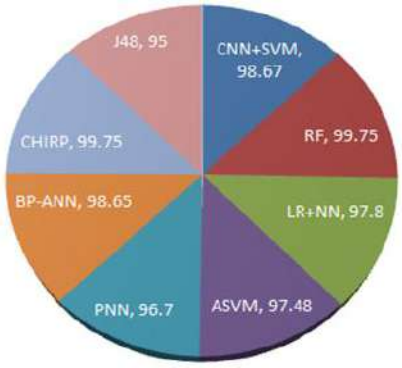

Figure 1.2. Accuracy comparison

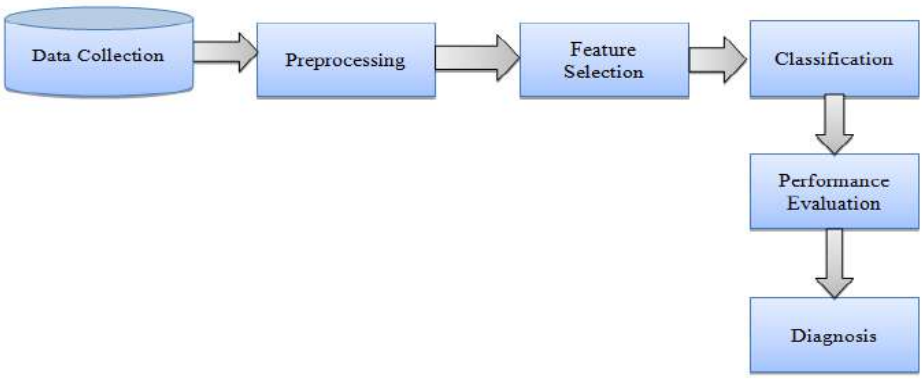

Figure 1.3Proposed CKD detection architecture

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RESEARCH ARTICLE

Cultivation of Milky Mushroom *Tricholoma giganteum* (TGS-1)

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ABSTRACT

Tricholoma giganteum is a commercially emerging wild edible milky mushroom. This mushroom was widely accepted by farmers because of its colour, texture, fleshy nature and better yield in summer season. In the cultivation aspect of the milky mushroom, Potato Dextrose Agar (PDA) and Beet Dextrose Agar (BDA) medium at neutral pH 7.0 and temperature ranging between 30-32°C, supported maximum radial growth and biomass production of *T. giganteum* (TGS-1).The spawn developed from the Sorghum grain recording minimum spawn run days and maximum yield. The paddy straw was the most efficient substrate in supporting the sporophore yield of *T. giganteum* (TGS-1). The combination of Well decompost FYM + Garden soil (1:1 w/w) gave the maximum sporophore yield with highest Biological efficiency value.

Keywords: *Tricholoma giganteum*, Summer mushroom, Cultivation.

INTRODUCTION

The role of modern technology in human civilization is expanding every day. However, humans still face three basic problems: shortage of food, environment pollution and diminishing quality of health because of the continuous increase in world population (Adenipekun and Omolaso 2015).India has achieved self-sufficiency in food grain production, but it contain low amount of proteins, minerals and vitamins. In India, widespread of malnutrition with "protein deficiency" is quite common in low income group of peoples and children. In developing countries including India has urged the search for alternative protein sources. Mushrooms were rightly had been identified as the best alternative food source to fight against malnutrition because of their excellent flavour, texture, medicinal and nutritional values (Verma 2014; Sandeep *et al*. 2018). In India, at present, four mushroom species *viz*., *Agaricus bisporus, Pleurotus* spp., *Volvariella* spp. and *Calocybe indica* have been recommended for cultivation. The Indian subcontinent is

known worldwide for its varied agro climatic zones with a variety of habitats that favour rich mushroom biodiversity. There are no mushrooms available for cultivation during summer season except *Calocybe indica* and *Volvariella volvacea,* but due to fibrous nature, a taste like radish of *Calocybe indica* and less shelf life of *Volvariella volvace*a, they are not accepted successfully by the farmers (Akhtar et al. 2019).*Tricholomagiganteum*Heim, is an edible mushroom pure white in colour resembling the morphology of *Calocybe indica,* was reported growing widely in summer in Indo-gangetic plains of Howrah district, Hooghly in India (Chakravarty and Sarkar 1982). The mushroom production is a globally expanding industry. Mushroom production in India for the year 2013 is roughly 1,29,000 tons contributing less than one per cent of total world production (Sharma et al. 2017). Milky white mushrooms are highly suitable for commercial production in humid tropical and subtropical regions of the world where, the average temperature falls between 25°C and 35°C throughout the year (Navathe et al.2014). Due to its morphological appearance, higher shelf life, higher productivity, white color and low production cost, milky mushroom will have greater acceptability in the world market. The mushroom has a resemblance to button mushroom, which may again help in picking up the demand for this mushroom in the world. It is rich in essential nutrients, natural antioxidants, antibacterial, antiviral and anti-microbial activities (Mehreen Zeb et al.2021).This naturally available mushroom was consumed by the local peoples. That's why we were move further for cultivation of the mushroom *T. giganteum*. In this view, the current study was undertaken to the efficacy of different cereal grains, Agricultural wastes and different combination of soils against the cultivation of the summer mushroom *T. giganteum* (TGS-1).

MATERIALS AND METHODS

The mushroom was collected from non-cultivable plains in O. Sowdapuram Village, Namakkal district, Tamil Nadu. The collected mushroom was isolated by standard tissue culture technique proposed by Sud (1995). The entire research was done in the Department of Plant Pathology, Annamalai University, Tamil Nadu. The isolate of *Tricholoma giganteum* (TGS-1) was sequenced and deposited in NCBI GenBank with the accession number MZ061712.

Evaluation of substrates

Six different cereals, millets, pulses seeds viz., Sorghum, paddy, wheat, cumbu, thenai and Bengal gram were used as a spawn substrate for the production of *T. giganteum.* The method for the preparation of spawn proposed by kerketta et al. (2018) has been followed. Healthy, cleaned, pre-soaked grains were boiled upto 20 minutes. After that, drained the water and add 20 g of calcium carbonate for avoid caking, neutralize the pH and remove excess moisture. After drying, the grains were filled to glucose bottle and sterilized in an autoclave under 121.6℃ with 15 psi pressure. Locally available Agricultural wastes *viz.,* paddy straw, sugarcane bagasse, dried banana leaf wastes, saw dust and coir pith were used as bed substrates. The substrates were sterilized by chemical methods, soaked in water along with 0.1% of carbendazim + 0.1%of formalin. 1000 g Substrates were used per bed with 65% moisture content. The biological efficiency was calculated by using the formula (Chang et al. 1981).

$$\text{Biological efficiency \%} = \frac{\text{Fresh weight of mushroom}}{\text{Dry weight of substrate}} \times 100$$

Evaluation of different casing materials

Mushroom bags were cut horizontally into two equal halves after completion of spawn run. The bags were gently pressed and the casing material was applied to a height of 2-3 cm. in this study, Red soil + garden soil (1:1 w/w), well decompost FYM + garden soil (1:1 w/w), well decompost FYM + garden soil (2:1 w/w), vermicompost + garden soil (1:1 w/w), vermicompost + garden soil (2:1 w/w) used as a casing materials. These materials sterilized by steam boiling.

RESULT AND DISCUSSION

Effect of different grain substrates on spawn production of *T. giganteum*

The Data presented in the table 1 revealed that the mycelium of the *T. giganteum* colonized sorghum grain substrates in 16.02 days. This was followed by paddy and wheat grains (17.66 and 19.32 days). Further, it was observed that the formation and the density of mycelia were found to be less in minor millets when compare to cereals and pulses. According to Eswaran et al. (1998) sorghum grain spawn provide better aeration, increased surface area and more space for the mycelial extension and colonization. Moreover the use of sorghum grain gives more number of spawn bottles per unit weight. Similarly, increase of mycelia growth and sporophore production of *T. giganteum* by using cereals spawn was also reported Bilal et al. (2014); Viveksingh et al. (2017); Akhtar et al. (2019); Priyadharshini et al. (2019).

Effect of bed substrates on the growth and sporophore yield of *T. giganteum*

Among the five different locally available substrates tested for their potentiality in supporting the sporophore formation of *T. giganteum*. (Table 2) It was found that the paddy straw was the most efficient in enhancing the yield (1334.0 g per bag), quick spawn running (15.2 days), earlier pinhead formation (21.1 days) of *T. giganteum*. Followed by dried banana leaves (1204.0 g per bag), sugarcane bagasse (1097.5 g per bag). Minimum fruiting bodies were obtained in the beds prepared by using saw dust as substrates. Similar to the present studies several earlier workers have reported the successful utilization of paddy straw as substrate for the cultivation of milky mushrooms (Latithadevy and josephin 2014; Mishra et al. 2015; Sathiyakeerthi et al. 2016; singh et al. 2017). Cereal straws are rich in cellulose, hemicellulose and lignin from which the mushroom derives the nutrients (Biswas and Biswas 2015; Thakur et al. 2020; Mane et al. 2007). Sarodee et al. (2021) reported that paddy straw as a best substrate because of the presence of favourable nutrients that are better utilized by fungus *T. giganteum*has the capacity to degrade cellulose, hemicellulose and lignin and to produce fruiting bodies. Lakshmipathy et al. (2017) showed paddy show as the best substrate for *C. indica* cultivation.

Effect of different casing materials on yield of *T. giganteum*

Out of five casing materials well decompost FYM + garden soil (1:1 w/w) showed quick impregation of the mycelium, earliest pinhead formation and harvest of the mushroom. Followed by FYM + gardening soil (2:1 w/w), Red soil + garden soil (1:1 w/w) showed earlier pinhead formation in 13.5 and 13.7 days with 1264.0 and 1258.0 g per bed with high biological efficiency. Vermicompost + garden soil (2:1 w/w) exhibited least sporophore yield of 986.75 g per bed with lowest biological efficiency (98.6 per cent). (Table 3)The present findings support the findings of Viveksingh et al. (2017), FYM + garden soil took the minimum days for pinhead formation and maximum yield. Shukla et al. (2008) reported that well decompost FYM + soil (2:1) tooks 14.4 days for pinhead formation with more sporophore yield. Combination of different casing materials perform better then alone. Compost + vermicompost gave high yield (813.33 g) with highest biological efficiency (81.33 per cent) (Nagaratna and mallesha 2007) similar trends were observed by some others (Kerketta et al. 2018b; Chakraborthy et al. 2010; Navathe et al. 2014).

CONCLUSION

The conclusion of the present study is to find out suitable medium (PDA), pH (7.0) and temperature (30 - 32℃) for mycelial growth of the milky mushroom *T. giganteum* and to develop cultivation methodology by recycling the locally available agricultural wastes to enhance farmers income. Sorghum grain was the best substrates for the spawn production. It was economically cheapest and easily available at market. Paddy straw was proved as best substrate and gave maximum sporophore yield (1330.0 g per bag) with highest biological efficiency (133.0 per cent). Among the five different combination of casing materials 2 – 3 cm height of the well decompost FYM + garden soil (1:1 w/w) provided maximum yield (1337.82 g per bag) with highest biological efficiency (133.7 per cent).

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Table 1: Effect of different spawn substrates on spawn production of *T. giganteum*

Tr. No.	Spawn substrate (grain)	Spawn run (days)	Sporophore yield (g)	Biological efficiency (%)
1	Bengal gram	21.14[d]	947.50[d]	94.8
2	Cumbu	22.78[e]	856.90[e]	85.7
3	Paddy	17.66[b]	1236.00[b]	123.6
4	Sorghum	16.02[a]	1304.00[a]	130.4
5	Thenai	24.65[f]	715.90[f]	71.6
6	Wheat	19.32[c]	1073.00[c]	107.3

*mean of three replications

*Values not sharing a common superscript differ significantly at P < 0.05 (DMRT)

Table 2: Effect of bed substrates on the growth and sporophore yield of *T. giganteum*

Tr. No.	Substrates	Spawn run (days)	Pinhead formation (days)	First harvest (days)	Total yield (g bed^{-1})	Biological efficiency (%)
1.	Saw dust	19.7^{d}	26.9^{d}	42.7^{d}	874.90^{d}	87.5
2.	Sugarcane bagasse	18.4^{c}	25.3^{c}	34.5^{c}	1097.50^{c}	109.8
3.	Paddy straw	15.2^{a}	22.1^{a}	31.6^{a}	1334.00^{a}	133.4
4.	Dried Banana leaves	16.8^{b}	24.7^{b}	32.9^{b}	1204.00^{b}	120.4
5.	Coir pith	18.6^{c}	25.7	34.9^{c}	1065.50^{c}	106.5

*mean of three replications

*Values not sharing a common superscript differ significantly at P < 0.05 (DMRT)

Table 3: Effect of different casing materials on yield of *T. giganteum*

Tr. No.	Casing materials	Pin head formation (Days)	First harvest (days)	Total yield (g bed^{-1})	Biological efficiency (%)
1.	Red soil + Garden soil (1:1 w/w)	13.7^{b}	21.9^{b}	1258.50^{b}	125.8
2.	Well decompost FYM + Garden soil (1:1 w/w)	12.9^{a}	19.5^{a}	1337.82^{a}	133.7
3.	Well decompost FYM + Garden soil (2:1 w/w)	13.5^{b}	21.6^{b}	1264.00^{b}	126.4
4.	Vermicompost + Garden soil (1:1 w/w)	14.8^{c}	23.6^{c}	1163.40^{c}	116.3
5.	Vermicompost + Garden soil (2:1 w/w)	15.6^{d}	24.6^{d}	986.75^{d}	98.7

*mean of three replications

*Values not sharing a common superscript differ significantly at P < 0.05 (DMRT)

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RESEARCH ARTICLE

Effect of Core Muscle and Lower Limb Strengthening and Pain Counselling for Nonspecific Low Back Pain on Marathon Runner's Performance - A Pilot Study

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ABSTRACT

The health benefits related to running are well-documented, with due consideration to lifestyle, diet, fitness and training methods in recent times. Physiotherapists are the one who attend such NSLBP which do not have a serious concern or surgical options, as they are often ignored by other consultants. LBP is a commonest health problem globally, that touches at least 80% of adult's lives and causes varying levels of disability based on how they are diagnosed and treated. The study was performed on 8 subjects who were sequentially screened and recruited out of a total 21 subjects. The subjects were randomly selected from a running club in Ahmedabad. The participants were all subjects with nonspecific low back pain diagnosed by a registered physiotherapist after complete physical examination and diagnostic testing. A total 21 were screened and finally 8 subjects were selected and recruited randomly into two groups with 4 in each group.

Keywords: Ahmedabad, LBP, health, subjects.

INTRODUCTION

The health benefits related to running are well-documented, with due consideration to lifestyle, diet, fitness and training methods in recent times. This has led to a drastic increase of the scope to enhance physical activity and interest among competitive and recreational runners. This is true even among subjects without an adequate

knowledge on training principles and methods [1-4]. Past researchers claim that running is one of the most proven ways to achieve a good health status and fitness [5]. However, there is literature that explains that running also involves a relatively increased risk for associated injury [6,7]. Previous literature reported that 11–85% of non-professional runners have at least once faced Running Related Injuries (RRIs) every year [6]. This is reported to reduce the training schedule among 30–90% of runners [7–9]. Acute RRIs are rare, approximately 80% of RRIs result from overuse, that result from imbalance between muscle and other connective tissue and abnormal biomechanical load distribution while running [10, 11]. The prevalence rate of RRI differs drastically among different types of runners (middle and long-distance runners) which ranges between 19 and 92% [2, 16–20]. However, the discrepancies among studies limit the comparison of data due to the divergences in the type of runners analyzed, follow-up provided, study design, ethology and definition of RRIs [12, 13]. In our study RRI is defined as "musculoskeletal pain or physical complaint of the lower limbs or of the back/trunk due to running, causing a total restriction or interruption of running for at least seven or more days and requiring therapeutic assistance" [14]. From this definition it is understood that RRI predominantly affect joints of the lower limb apart from affecting the integrity with pelvis and lumbar spine [14, 15], which manifest as muscle pain or weakness, tendons and joints injury, which reflects as nonspecific low back pain (NSLBP) [9-15]. In the 90% of patients, the LBP is classified as non-specific, because the underlying patho-anatomical or biomechanical causes are not clearly evaluated and understood by the physicians. [16]. Physiotherapists are the one who attend such NSLBP which do not have a serious concern or surgical options, as they are often ignored by other consultants. LBP is a commonest health problem globally, that touches at least 80% of adult's lives and causes varying levels of disability based on how they are diagnosed and treated. [17,18] Hence in this study we have taken an effort to find the effect of combining core muscle and lower limb strengthening and pain counseling for nonspecific low back pain on marathon runner's performance.

METHODOLOGY

The study was performed on 8 subjects who were sequentially screened and recruited out of a total 21 subjects. The subjects were randomly selected from a running club in Ahmedabad. The participants were all subjects with nonspecific low back pain diagnosed by a registered physiotherapist after complete physical examination and diagnostic testing. The subjects were marathon runners recruited from the Ahmedabad distance runners (ADR) group, Ahmadabad, Gujarat, India. The subjects were allotted into two intervention-based groups namely Group A and Group B. The pre-test analysis (Baseline analysis) was performed on the subjects before the commencement of the intervention (A Day before). The subjects underwent intervention based on the group they belong to for 4 weeks. A post-test analysis was performed at the end of this intervention period (one day after the intervention ended). Group A received Strengthening exercises for core muscle and lower limb muscles and Group B subjects received Strengthening exercises for core muscle and lower limb muscles along with pain counseling according to bio psychosocial (BPS) pain models. Both the groups received 3 days of intervention on alternating days a week for 4 weeks with one session of intervention for 60 min. Group A received 45 min of exercises session and 15 minutes of educating dos and don'ts and general orientation and group B received 45 min of exercises session and 15 minutes of Pain counseling. The following three outcome measures were used to analyze the prognosis: Roland & Morris Disability Index, the Central Sensitization Inventory and the Athlete Life Quality Scale. The subjects were randomly assigned into two groups using a random table method and concealed envelope method was used for avoiding allocation bias. Those who assessed the outcomes were blinded to group assignment, they were not involved in any of the activity of the pilot trial and were from a different institution. As all the three outcome measures were ranking scale the data were considered to be non-parametric in nature and adding to it was a small sample with no normal distribution. Hence Wilcox on sign rank test was used for within group analysis and a Mann Witney U test was used for between group analysis. The significance level was < 0.05 with a 95% confidence interval.

RESULTS

A total 21 were screened and finally 8 subjects were selected and recruited randomly into two groups with 4 in each group. Number of participants analysed in each group for the pilot objectives were 4 in each group which meant there were no dropouts. The demographic baseline characteristics of the participants are presented in table 1. The between group analysis and the within group analysis showed that groups were not similar at the time of assignment into two groups with a significant difference between all the three pretest values with a p value of <0.05. It is evident from the central tendency and distribution of data that the group B subjects fared poorly at the start compared to the group B (table 2). The within group analysis showed that both the groups resulted in a significant improvement with three outcome measures, however the effect size of group B was greater than the other. The between group analysis of post test values also showed that there was a significant difference between the two groups with group b performing significantly better. The results of between group analysis are displayed in table 3 and within group are displayed in table 4.

DISCUSSION

This study was a preliminary pilot study to understand the feasibility of a large sample clinical trial. The study involved all professional runners who preferably participated in long distance running. It is documented that identification of the gaps in athletic empowerment with knowledge of management of pain among elite athletes will render a unified direction for the retrieval of information. There is always an emphasise on giving reassurance, speedy return to active sport, in athletic rehabilitation. [3,19,20]. The pilot study clearly demonstrated that the improvement gained during the end of 3rd weeks were not different from the end of the fourth week however that was not documented in the study. Muscle power or endurance of the low back muscle may play a vital role in the long-distance runners which needs to be analyzed in future studies. Muscle power of any muscle will improve significantly after 6 weeks which is proved by physiological studies, hence 3 months follow up of the patients treated will be ideal to know the long-term outcome of subjects treated. From the study we infer that reducing the intervention time to 3 weeks would be a better option when working on the future studies that are performed on larger samples on similar population. [20] As we found that the athletes lacked in endurance when performing long distance running, we would suggest adding endurance training for core muscle in the future studies. To know the prognosis in a temporal manner we would suggest adding multistage outcome analysis by increasing the frequency of post-test analysis as this may help reducing the duration and cost for rehabilitation and enhance the return to sports at the earliest. Last but not least we would suggest adding along-term outcome analysis using a follow up for 6 months or a year to know the sustainability of treatment effect.

CONCLUSION

The pilot study concludes that though Strengthening exercises for core muscle and lower limb muscles strengthening results in better prognosis of pain, pain counseling resulted in a better quality of life and modifies pain sensitization process.

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Table 1 - Demographic baseline characteristics of the participants

Criteria	Group A	Group B
Age	26.4 (2.4)	29.1 (3.6)
Sex	Male 3, female 1	Male 2, female 2
Duration of symptoms	120 (15) days	150 (15) days
Monthly mileage	7.5 kms	9 kms

Table 2 – The central tendency and distribution of groups in pre and post-test.

	Group A-Pre Mean (SD)	Group A-Post Mean (SD)	Group B-Pre Mean (SD)	Group B-Post Mean (SD)
Roland & Morris Disability	20.25 (3.86)	15 (2.36)	22 (2.64)	13 (1.82)

Index				
Central Sensitization Inventory	44 (6.60)	34 (7.57)	50 (5.97)	24 (3.0)
Athlete Life Quality Scale	48 (9.97)	58 (8.16)	42 (7.71)	74 (9.57)

Table 3 between group analysis of pre test and post test values

Outcome	Test	Z value	P value
Roland & Morris Disability Index	Pre test	-2.58	0.048
	Post test	-2.78	0.028
Central Sensitization Inventory	Pre test	-1.88	0.049
	Post test	-2.89	0.001
Athlete Life Quality Scale	Pre test	-2.12	0.040
	Post test0	-3.21	0.001

Table 4within group analysis of group A and group B values

Outcome	Test	Z value	P value
Roland & Morris Disability Index	Group A	-1.48	0.044
	Group B	-2.18	0.018
Central Sensitization Inventory	Group A	-1.28	0.047
	Group B	-2.92	0.001
Athlete Life Quality Scale	Group A	-0.22	0.088
	Group B	-3.28	0.001

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RESEARCH ARTICLE

Antibacterial Activity and GC- MS Analysis of Selected Medicinal Plants against Nosocomial Bacterial Pathogens

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ABSTRACT

The medicinal plants of *Phyllanthus amarus, Adhatodavasica*, *Solanumtrilobatum* and *Leucasaspera* leaves were collected from Chidambaram at Cuddalore district. The ethanol, methanol and chloroform medicinal plants extracts were tested against nosocomial bacterial pathogens viz., *Escherichia coli*, *Klebsiellapneumoniae, Pseudomonas aeruginosa* and *Bacillus cereus* by disc diffusion method. Among four tested medicinal plants, the *Phyllanthus amarus* showed highest antibacterial activity against all tested nosocomial bacterial pathogens. The GC-MS analysis of the plants *Phyllanthus amarus* revealed the presence of 13 standard compounds were used only the ditetrazolol, 5 - A: 5, 1- C Pyrazine (3.510) compound have been detected. We concluded that the *Phyllanthus amarus* investigated in this study are useful sources of nature antibacterial, which confer significant protection against free radical damage.

Keywords: Medicinal plants, Antibacterial activity, nosocomial bacterial pathogens, GC-MS analysis.

INTRODUCTION

Nosocomial or healthcare associated infections (HCAI) arise in a patient who was not present at the time of admission but is now receiving medical care in a hospital or other health care institution. These infections can emerge during the treatment of other disorders as well as after the patients have been discharged. They also include occupational illnesses among medical personnel [1]. Greater infections lead to longer hospital stays, long-term impairment, increased antimicrobial resistance, increased socio-economic disruption, and higher mortality rates. Because of poorly developed monitoring systems and lack of control mechanisms, data on the burden of nosocomial

infections is scarce. For example, many patients are likely to get respiratory infections while receiving treatment for other illnesses, making it difficult to detect the incidence of any nosocomial infection in a primary care setting [2]. *Acinetobacter baumannii*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa*, which cause respiratory tract infections, are developing multidrug resistance. This complicates antimicrobial treatment [3-5].

Medicinal plants include a wide range of phytochemicals, including amino acids, vitamins, hormones, steroids, phenols, tannins, flavonoids, carotenes, xanthophylls, saponins, fats, lipids, and protein, many of which have amazing disease-curing qualities. If handled correctly, these natural compounds are completely safe for humans. Synthetic medicines made in laboratories can injure the human body if used in big amounts for lengthy periods of time. Toxins are left in human bodies that are difficult to eradicate. Many human illnesses are caused by these poisons. Medicinal plants are capable of eliminating these toxins and detoxifying the body on their own. Toxin-removal characteristics are found in natural therapies. Many plants have been employed for their antibacterial properties, which are related to chemicals produced in the plant's secondary metabolism. These goods are identified by their active ingredients, such as the phenolic compounds found in essential oils and tannin [6,7].

Antimicrobial active principles are extensively dispersed across plants, thanks to a variety of extraction and synthesis methods that have been thoroughly investigated. Despite this, reports of indigenous antimicrobial activity have been thoroughly contacted. Plants produce antimicrobial chemicals that are active agents against plant and human pathogenic microorganisms [8]. Plant extracts and their physiologically active chemicals have long been an useful source of natural goods that have aided in the prevention and treatment of diseases, as well as the maintenance of human health [9]. Furthermore, they are widely accepted due to a widespread belief that they are safe and have a long history of usage in folk medicine to treat ailments and illnesses dating back to ancient times [10].

EXPERIMENTAL PLANTS

Phyllanthus amarus

Botanical name :*Phyllanthus amarus*
Plant family :Euphorbiacea
Common name :Bahupatra

It is a traditional ayurvedic herb used to cure jaundice in southern India. Except for Australia, it grows profusely in the tropical regions of all countries. It grows abundantly during the rainy season as a weed in wastelands and agricultural regions. The plant's alcoholic extract shows anti-cancer properties in mice with Freud virus leukaemia and antispasmodic properties in isolated guinea pig ileum.

Adhatoda vasica

Botanical name :*Adhatoda vasica*
Plant family :*Acanthacaea*
Common name :Adathodai, Malabar nut.

Adathoda leaves have been utilised in ayurvedic medicine for over 2000 years, particularly to treat respiratory problems. Plants grow up to 1000 metres above sea level in lowlands and the lower Himalayan range. Bronchodilator and antihistaminic properties have been observed in the active alkaloid vaccine and its auto oxidation product vasicinone.

Solanum trilobatum

Botanical name :*Solanum trilobatum*
Plant family :Solanaceae
Common name :Mullamusthi, alarka

This is herb has been praised as Kayakalpam by our ancient and saints. This creeper grows widely through India. It grows wild on the hedges. This leaf is stimulant, expectorant, tonic and brain stimulant.

Leucas aspera
Botanical name :*Leucas aspera*
Plant family :Lamiaceae
Common name :Tumba, dronapushpi.
It was used in the cure of insect's bits, paralysis, cough. It grows wild in plain all over India. Laxative, expectorant, antipyretic, insecticide activity.

MATERIALS AND METHODS

Collection and drying of plant leaves
Healthy leaves of *Phyllanthus amarus, Adhatodavasica*, *Solanumtrilobatum* and *Leucasaspera* were collected from Chidambaram at Cuddalore district. The leaves of plants were washed thoroughly three times with water and once with distilled water. The collected leaves materials were air dried at room temperature and then grounded into uniform powder and the powdered samples were hermetically sealed in separate polythene bags until the time of the extraction.

Extraction of plant material
20g of powdered leaves was extracted successively with 100 ml of ethanol, methanol and chloroform in Soxhlet apparatus until the extract was clear. The extracts were evaporated to dryness and the resulting pasty form extracts were stored in a sterile plastic container.

Test microorganisms
The bacterial sp. used for the study were *Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae* and *Proteus mirabilis*. All the stock cultures were obtained from RMMCH, Annamalai Nagar, Chidambaram, Tamil Nadu, India. The organisms were sub cultured and maintained in nutrient agar slant at 4 °C.

Antibacterial assays
The paper disc method was used to determine the growth inhibition of bacteria by the plant extracts of *Phyllanthus amarus, Adhatodavasica*, *Solanumtrilobatum* and *Leucasaspera*. Petri plates were prepared by pouring 10 ml of Muller-Hinton agar for bacteria and allowed to solidify and were seeded with 24 hr old culture of selected bacterial strains (10^6 cells ml^{-1}) sterile Whatman No.1 filter paper discs (6 mm diameter) containing 1 percent. Streptomycin was used as positive control. The Muller - Hinton agar assay plates used for testing bacterial susceptibility were incubated at 37ºC for 24 hr. Assessment of antibacterial activity was based on the measurement of diameter of inhibition zone formed around the disc. Antibacterial activity was tested using disc diffusion method.

GC - MIS Study on *Phyllanthusamarus*
Preparation of plant extract
20 g of powdered plant material was soaked in 50 ml of absolute alcohol overnight and then filtered through Whatman filter paper No.1 along with 2 g of sodium sulphate to remove the sediments and traces of water in the filtrate. Before filtering, the filter paper along with sodium sulphate was wetted with absolute alcohol. The filtrate was then concentrated by bubbling nitrogen gas into the solution and reduced the volume to 1 ml. The extract contains both polar and non-polar phytocomponents of the plant material used.

GC - MS Condition
GC- MS was performed with Hewlett - Packed Compounds were separated on a 30m x 0.25mm capillary column coated with a 0.25µm film of HP-5 sample were injected with a split ratio of 50:1; helium was used as carrier gas at 1.0 ml min^{-1}. The column temperature was maintained at 110ºC for 2 minute, after injection then increased at 10ºC min^{-1} to 200ºC again temperature was get up to 28ºC. The time required for chromatography of one sample 36 minutes.

Analysis of the Phytocomponents in *Phyllanthus amarus* using GC-MS technique

One micro litre of the filtrate was injected into the GC - column. There the sample get evaporated and carried away by the carrier gas, helium and it get segregated into individual components. The sample fraction coming out of the column was let into the mass detector and the mass spectrum of each component was recorded. The mass spectrum of the unknown component was compared with the known spectrum of NIST library and the components were identified.

RESULTS

Inhibitory effect of plant extracts against *Escherichia coli*

Inhibitory effect of medicinal plant extract against *Escherichia coli* was done. The *Phyllanthus amarus* extract was showed that 1% methanol extract (20 mm), 1% ethanol extract (15mm) and 1% chloroform extract (19mm). The *Solanumtrilobatum* extract was showed that 1% methanol extract (11 mm), 1% ethanol extract (10 mm) and 1% chloroform extract (16 mm). The *Adhatodavasica* extract was showed that 1% methanol extract (13 mm), 1% ethanol extract (11 mm) and 1% chloroform extract (11 mm). The *Leucasaspera* extract was showed that 1% methanol extract (15 mm), 1% ethanol extract (13mm) and 1% chloroform extract (15 mm). Among the four plant extract the *Phyllanthus amarus* all extract showed that higher antibacterial activity against *Escherichia coli.* (Table .1).

Inhibitory effects of plant extracts against *Pseudomonasaeruginosa*

Inhibitory effect of medicinal plant extract against *Pseudomonasaeruginosa* was done. The *Phyllanthus amarus* extract was showed that 1% methanol extract (18 mm), 1% ethanol extract (16 mm) and 1% chloroform extract (16 mm). The *Solanumtrilobatum* extract was showed that 1% methanol extract (11 mm), 1% ethanol extract (10 mm) and 1% chloroform extract (07mm). The *Adhatodavasica* extract was showed that 1% methanol extract (12 mm), 1% ethanol extract (10 mm) and 1% chloroform extract (10mm). The *Leucasaspera* extract was showed that 1% methanol extract (15 mm), 1% ethanol extract (13 mm) and 1% chloroform extract (10 mm). Among the four plant extract the *Phyllanthus amarus* all extract showed that higher antibacterial activity against *Pseudomonasaeruginosa* (Table. 2).

Inhibitory effect of plant extracts against *Klebsiella pneumoniae*

Inhibitory effect of medicinal plant extract against *Klebsiella pneumoniae* was done**.** The *Phyllanthus amarus* extract was showed that 1%methanol extract (25 mm), 1% ethanol extract (20mm) and 1% chloroform extract (22mm). The *Solanumtrilobatum* was showed that 1% methanol extract (17 mm), 1% ethanol extract (15 mm) and 1% chloroform extract (18 mm). The *Adhatodavasica* extract was showed that 1% methanol extract (12 mm), 1% ethanol extract (14 mm) and 1% chloroform extract (10 mm). The *Leucasaspera* extract was showed that 1% methanol extract (15 mm), 1% ethanol extract (12 mm) and 1% chloroform extract (10 mm). Among the four plant extract the *Phyllanthus amarus* all extract showed that higher antibacterial activity against *Klebsiella pneumoniae* (Table. 3).

Inhibitory effect of plant extracts against *Proteus mirabilis*

Inhibitory effect of medicinal plant extract against *Proteus mirabilis* was done. The *Phyllanthus amarus* extract was showed that 1% methanol extract (19 mm), 1% ethanol extract (15 mm) and 1% chloroform extract (16 mm). The *Solanumtrilobatum* extract was showed that 1% methanol extract (13 mm), 1% ethanol extract (10 mm) and 1% chloroform extract (12 mm). The *Adhatodavasica* extract was showed that 1% methanol extract (13 mm), 1% ethanol (14 mm) extract and 1% chloroform extract (15 mm). The *Leucasaspera* extract was showed that 1% methanol extract (15 mm), 1% ethanol extract (14 mm) and 1% chloroform extract (10 mm). Among the four plant extracts the *Phyllanthus amarus* all extract showed that higher antibacterial activity against *Proteus mirabilis* (Table. 4).

GC-MS study on *Phyllanthusamarus*

In this analysis, GC-MS technique is used to analyze the plant material. This important analytical technique is composed of gas chromatography and mass spectrometry which have been combined. GC was developed as a means for separating mixture into main compound substances. Mass spectrum would be summation of the spectra of

the all compound. In our study was obtained the *Phyllanthus amarus* plants were detected by using GC- MS. In this method 13 standard compound was used only the ditetrazolol, 5 - A: 5, 1- CPyrazine (3.510) compound have been detected. The aqueous methanol and n -butanol extracts of aerial parts of *Solanum trilobatum* L. (Solanaceae) were tested for antimicrobial activity by disc diffusion method. From the results, it was found that extracts from leaves, flowers, stem and fruits revealed antimicrobial activity against Gram (+) and Gram (-) bacteria. Maximal antibacterial activity was seen against *Klebsiella pneumoniae* with aqueous extract whereas methanol extract of stem showed maximal activity against *Staphylococcus aureus*. The Minimum Inhibitory Concentration (MIC) exhibited by *S. trilobatum* aqueous extracts against tested organisms ranged between 0.06 - 0.5 mg/ml [11].The samples of natural honey from different medicinal plants have antimicrobial activities on antibiotic resistant strains of bacteria isolated from human pathology.

Samples of honey from four different plants mainly *Thespesial populned, Calotropis gigantean, Leucas aspera, Azadirachta indica* and multifloral were collected from different regions in Tamil Nadu. Dilutions of honey ranging from 1/2, 1/4, 1/8, and 1/16 were tested by the agar well diffusion method on various strains of bacteria including *Escherichia coli*, *Staphylococcus aureus*, *Bacillus* sp. and *Pseudomonas* sp. Therefore an attempt was made to study the antimicrobial properties of *Leucas aspera* plant extracts against four nosocomial bacterial pathogens [12].The antibacterial activity of valuable compounds from various solvent extracts of *Anosomeles indica, Blumea cera and Melia azadirachta* against *Escherichia coli, Pseudomonas aeruginosa, Serratia maraceseuns* and *Staphylococcus aureus* by tube diffusion method. Acetone and methanol extracts of all plants showed strong antibacterial effect, whereas petroleum ether and aqueous did not exhibit any effect. *Pseudomonas aeruginosa* and *Serratiamarcesenes* were relatively more sensitive [13]. This study can be performed the nosocomial bacterial pathogens viz., *Escherichia coli* and *Pseudomonas aeruginosa* also the inhibitory activity against the medicinal plants.

CONCLUSION

In the present study the antibacterial activity of medicinal plant extracts against *Escherichia coli* and *Klebsiella pneumoniae* was shown to be highest in ethanol, methanol, and chloroform extracts, followed by *Pseudomonas aeruginosa*, *Proteus mirabilis* and *Bacillus subtilis*. GC-MS technology was used to identify respective inhibitory bioactive components from the best medicinal plants. The therapeutic plants will be used to develop a medication system that will eventually be used to combat horrible microbiological infections, saving humanity. The current investigation demonstrated the antibacterial activities of *Phyllanthus amarus* leaf extract, which can be used instead of manufactured drugs to combat bacterial toxicity and resistance.

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Table 1: Inhibitory effect of plant extracts against *Escherichia coli*

Medicinal plants	Zone of inhibition (mm)		
	1% methanol	1% ethanol	1% Chloroform
Phyllanthus amarus	20mm	15 mm	19 mm
Solanum trilobatum	11 mm	10 mm	16 mm
Adhatoda vasica	13 mm	11 mm	11 mm
Leucas aspera	15 mm	13 mm	15 mm

Table2: Inhibitory effects of plant extracts against *Pseudomonasaeruginosa*

Medicinal plants	Zone of inhibition (mm)		
	1% methanol	1% ethanol	1% Chloroform
Phyllanthus amarus	18 mm	16 mm	16 mm
Solanum trilobatum	11 mm	10 mm	07 mm
Adhatoda vasica	12 mm	10 mm	10 mm
Leucas aspera	15 mm	13 mm	10 mm

Table3: Inhibitory effect of plant extracts against *Klebsiella pneumoniae*

Medicinal plants	Zone of inhibition (mm)		
	1% methanol	1% ethanol	1% Chloroform
Phyllanthus amarus	25 mm	20 mm	22 mm
Solanum trilobatum	17 mm	15 mm	18 mm
Adhatoda vasica	12 mm	14 mm	10 mm
Leucas aspera	15 mm	12 mm	10 mm

Table 4: Inhibitory effect of plant extracts against *Proteus mirabilis*

Medicinal plants	Zone of inhibition (mm)		
	1% methanol	1% ethanol	1% Chloroform
Phyllanthus amarus	19 mm	15 mm	16 mm
Solanum trilobatum	13 mm	10 mm	12 mm
Adhatoda vasica	13 mm	14 mm	10 mm
Leucas aspera	15 mm	14 mm	10 mm

Table 5: Bioactive compound detected from extract of *Phyllanthus amarus*

Hit	Compound Name	Formula	M.W.
1	2(1H)-PYRIDINETHIONE, 3-ETHOXY-6-METHYL- (CAS) $$ 3-E	C8H11ONS	169
2	2(1H)-PYRIDINETHIONE, 3-ETHOXY-6-METHYL-	C8H11ONS	169
3	CYCLOPENTANAMINE, 1-METHYL- (CAS) $$ 1-METHYLCYCL	C6H13N	99
4	6-ETHYL-2,3,11,12-DIBENZO-1,4,7,10,13,16-HEXAOXACYCLO	C22H28O6	388
5	DITETRAZOLO 1,5-A:5',1'-C PYRAZINE	C4H2N8	162
6	2-PENTYN-1,5-DIOL $$ 2-PENTYNE-1,5-DIOL $$ 3-PENTYNE-	C5H8O2	100
7	2-PROPENENITRILE	C3H3N	53
8	BIS(2-CYANOETHYL)ETHER	C6H8ON2	124
9	2-BUTENEDIAMIDE, (E)-	C4H6O2N2	114
10	2-BUTENEDIAMIDE, (E)- (CAS) $$ FUMARIC DIAMIDE $$ FUM	C4H6O2N2	114
11	1H-1,2,4-TRIAZOLE-3-CARBOXALDEHYDE, 5-METHYL-	C4H5ON3	111
12	1,3-CYCLOBUTANEDICARBONITRILE, CIS-	C6H6N2	106
13	BICYCLO 3.1.0 HEXAN-3-ONE	C6H8O	96
14	BUTANOIC ACID, 4-CHLORO-, ETHYL ESTER	C6H11O2Cl	150
15	PENTANEDINITRILE, 2-METHYL-	C6H8N2	109
16	BUTANOIC ACID, 4-CHLORO-, ETHYL ESTER (CAS) $$ ETHY	C6H11O2Cl	150
17	1,3-CYCLOBUTANEDICARBONITRILE, TRANS-	C6H6N2	106
18	2-ETHOXY-3,4-DIHYDRO-2H-PYRAN-6-CARBONITRILE $$ 2H-	C8H11O2N	153
19	2-PROPENAMIDE, N-METHYL- (CAS) $$ N-METHYLACRYLAM	C4H7ON	85
20	2-BUTYNE	C4H6	54

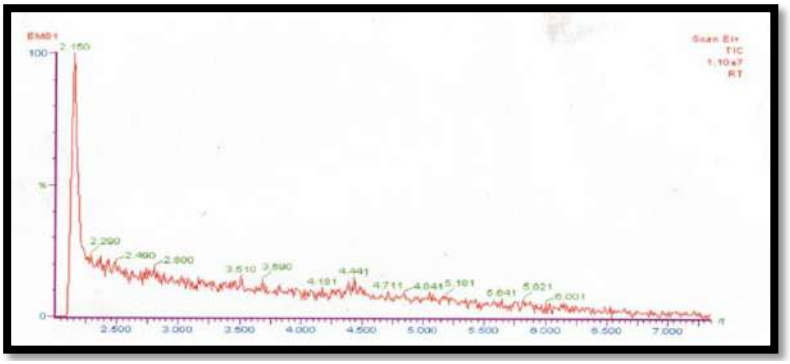

Figure 1: GC-MS chromatogram extract of *Phyllanthus amarus*

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RESEARCH ARTICLE

Role of Operation Research in the Pharmaceutical Sector

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ABSTRACT

Management science is an application of operations research to business. Operation research is the subject which can be used to solve problems relating to the management and coordination of organizational activities. In the twenty-first century, the fields of medicine, healthcare, and pharmaceuticals are flourishing, and their importances are increasing regularly. The pharmaceutical industry is one where extensive operations are carried out with the assistance of experts from numerous different professions and sectors. Operation research is used in a variety of techniques to improve the efficiency of the processes involved in the invention, production, expansion and marketing of their drugs. The objective of this paper is to provide the knowledge of applications of operation research in pharmaceutical industry.

Keywords: Operation Research, Management, Pharma, Healthcare, Industry

INTRODUCTION

Pharmaceutical progressions are very complex, which consists of many issues such as manufacturers, location, manpower and raw materials and storage. The management of such activities is not an easy job and therefore pharma industries arrange various resources and manpower to handle such activities. The use of operation research solve these issues very efficiently and provides the optimum results.

MANAGEMENT IN STRATEGIC AND OPERATIONAL PORTFOLIO

Pharmaceutical firms must manage a portfolio of various products and their development in order to effectively apply pharmaceutical analysis to improve production and business. It's difficult enough to manage one product alone. However, it would be extremely dangerous for a pharmaceutical company to rely solely on one medication to

generate revenue and run its business effectively. Therefore, it is crucial for businesses to include operations research into their daily operations.

The development activities are modeled as a network of probabilistic activities, where each activity has a time limit, a hierarchy of precedence, a list of resources it needs, and a chance of success. Risk is defined as the unfavourable effects of exposure to uncertainty, and in this context, risk is typically associated with the early withdrawal of a proposed medicine. A decision set's risk and possible reward must be weighed equally and therefore, the potential reward can be assumed as the expected financial returns of medicines obtained by the development process. The risk/reward ratio can then be used to compare different medicines or drugs.

MANAGEMENT IN SUPPLY CHAIN

Operation Research in pharmaceuticals assists companies in defining strategy, redesigning drug distribution networks, benchmarking performance, identifying issues during distribution, improving service levels, managing risk associated with transport and stock piling, reducing backorders, and reducing inventory. A hierarchical method was analyzed by Linninger *et. al*. [2] with a focus on the use of knowledge base and material balancing to identify and evaluate possibilities at every level of growth. The development of low-impact methods and synthesising approaches are the main areas of focus.

In order to maintain optimal levels of inventory, biopharma uses the Retrospective Optimization Integer Programming (ROIP) technique. To optimise inventory parameter settings along a sample path, ROIP employs an integer programme. An approximate method based on stochastic gradient search techniques can be utilised because particularly complicated supply chain configurations produce large, challenging integer problems. According to a numerical analysis, a hybrid strategy that combines integer programming with stochastic gradient search can generate answers that are only a small percentage off from those produced by the integer program while cutting down on solution times from over few hours to a few seconds.

Companies have gained a thorough grasp of external suppliers and contract management organisations that includes their capabilities and typical costs, with the use of Operation Research (CMOs). They have assisted clients in capturing both short-term and long-term value in several projects through their market expertise and experience. Working with clients to construct a thorough external supply strategy, segment vendors, develop measurements for vendor performance, and establish unambiguous management rules are all part of Operation Research's methodology. Many pharmaceutical companies have now decided to deliver their clinical trial programmes through preferred partnership agreements with Contract Research Organizations (CROs). They run these programmes since they must keep up with a variety of clients in order to develop responsive clients. Additionally, it gives them access to a talent pool that is much larger than the one that might be held by a single pharmaceutical company.

APPLICATION OF ABC AND VED ANALYSIS

Through the use of lean manufacturing techniques, operations research improves shop floor production efficiency. An approach of categorising items or activities according to their relative importance is Always Better Control (ABC) analysis. The phrase "separating the important few from the inconsequential many" refers to the fact that, for any collection of factors that together produce a common impact, a relatively small number of contributors account for the vast majority of the consequences. The ABC analysis's drawback is that it only considers the item's monetary worth and rate of consumption. Pharmaceutical businesses frequently utilise ABC analysis to determine which production techniques are both affordable and secure to adopt. Additionally, it aids them in comprehending the product blend that is simple to create using the given resources.

The Vital Essential and Desirable (VED) analysis is another method that is based on the item's critical values and shortage cost. The objects could be divided into three groups based on how crucial they are: vital, essential, and desired. To develop a significant control over the material supply, a combination of ABC and VED analysis (ABC-VED matrix) can be successfully used. All essential and pricey things fall under Category I. (AV, BV, CV, AE, AD).

The remaining goods from the E and B groupings are included in Category II (BE, CE, BD). The appealing and affordable set of things are in Category III (CD). It results in a better comprehension of the production techniques that businesses can use to meet medicine demand by maximising their resources and supplies.

CAPACITY PLANNING

In order to model the problem, Rotstein *et. al.* [3] employed a two-stage stochastic programming with recourse formulation and a scenario tree to represent the results of the trials. The "here-and-now" decisions involving immediate capacity expansions and the "wait-and-see" ones involving additional capacity expansions, the discontinuation of plants or products, and production and inventory planning all depend on the results of trials. They demonstrate how various options can be contrasted using a variety of criteria, such as expected net present value (NPV), the likelihood that the NPV will be negative, the worst-case scenario, the total amount of demand satisfied by all feasible products, and the total amount of demand satisfied by the products selected from the portfolio.

According to Papageorgiou *et. al.* [8], a multistage stochastic optimisation problem is employed when distinct products are at different phases in their life cycles, with the conclusion of each stage reflecting the end of a clinical trial. Based on standard industrial procedures, this experiment uses four outcomes - failure, low, target, and high. This indicates that each stage needs four scenarios. Additionally, for a problem with N stages (i.e., N products in trials), there is one scenario in the first stage (reflecting products already on the market with well-predicted demand), four scenarios in the second stage (reflecting the four possible outcomes for the first pipeline product to come out of trials), and 16 scenarios in the third stage (reflecting the combinations of outcomes for the two products), till the last step, which has 4N scenarios. The problem transforms into a large-scale stochastic programming problem with integer and continuous decisions when each scenario is linked to potential capacity expansions, production and inventory planning variables, and limitations. A huge MILP is used to solve it.

MODELLING IN INVENTORIES

The modelling of inventories is done using mathematics. Using a (s, S) policy for each product [11] offer a multi-product inventory management model that focuses on pharmaceutical inventory management in a single care unit. The authors proposed a number of simpler models as a result of the difficulty in solving the full model that takes into account product volume and space limits. They shown that applying these simplified models can lead to a decrease in inventory costs of up to 80%.

MANAGEMENT IN RESOURCE AND TASKS

A methodology for the sequencing and scheduling of testing tasks under resource restrictions was developed by Jain and Grossmann [4]. Each product in this strategy has an own set of testing tasks. Each task has a length, cost, precedence restrictions, resource requirements, and success probability. At a higher cost, a task could be outsourced; in this scenario, no internal resources would be needed. A product's income is expressed as a function of when it was introduced to the market. The established formulation is conservative and always realisable since the resource limitations are always applied, regardless of the likelihood that a task will not really be carried out. Modeled as an estimated cost is the cost component. This makes sure that the effect of starting tasks sooner than necessary is modelled, which prevents later jobs from actually happening as a result of the failure of the earlier one. In a word, the suggested MIP-based solution method comprises of two main procedure steps: I the constructive step and (ii) the improvement step, and its core is the MIP scheduling framework. The goal of the constructive stage is to quickly create a workable schedule for the production of drugs. Then, in the improvement step, this schedule is steadily improved by employing a number of complex rescheduling strategies and modifying machinery setup. As a sequence, it is preferred to provide workable and passable schedules in a respectable amount of time.

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RESEARCH ARTICLE

Impact of Collated use of Inorganic NPK Fertilizers, Poultry Manure, Biofertilizers and Seaweed Extract on Soil Nutrient Status of Gingelly (*Sesamum indicum* L.) Grown Soil

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ABSTRACT

A field experiment entitled "impact of collated use of inorganic NPK fertilizers, poultry manure, biofertilizers and seaweed extract on soil nutrient status of gingelly grown soil" was conducted in farmer's field at Vallampadugai village, near Chidambaram Taluk, Cuddalore district, Tamil Nadu. The experiment consisted of ten treatments of integrated nutrient management were tested in randomized block design with three replications, using sesame variety VRI-2. The soil of experimental field was sandy loam in texture, low in organic carbon (3.21 g kg^{-1}) and available nitrogen (216.2 kg ha^{-1}), medium in available phosphorus (13.8 kg ha^{-1}) and potassium (277.3 kg ha^{-1}) and deficient in available sulphur (7.9 mg kg^{-1}).The results revealed that nutrient management treatments showed significant influence on soil nutrient status in gingelly grown soil. The highest soil nutrient availability was recorded in the combined application of 75% RDF + poultry manure @ 10 t ha^{-1} through soil application along with foliar application of seaweed extract @ 15 % at 30, 60 DAS and at harvest stages.

Keywords: gingelly, INM, NPK, poultry manure, seaweed extract, soil nutrient status

INTRODUCTION

Oilseeds are the main source of fats and protein particularly for vegetarians. Sesame or gingerly (*Sesamum indicum* L.) commonly known as 'til' is also called as "queen of oilseeds" and has been known to be one of the earliest domesticated edible oilseed used by the mankind. The crop is grown in wide range of environments extending from semi-arid tropics and subtropic. It has high nutritional, medicinal, cosmetic and cooking qualities. Oleic and linoleic acids are the predominant fatty acids of sesame oil that have many dietary and health benefits for humans. India ranks first in area, production and export of sesame in the world. Sesame ranks third in terms of total oilseed area and fourth in terms of total oilseed production in India. The area, production and productivity of sesame are higher in summer season than those of post-kharif and kharif seasons. Lower productivity of sesame is due to the use of sub-optimal rate of fertilizer, poor management and cultivation of sesame in marginal and sub-marginal lands where deficiency of macro and secondary nutrients such as nitrogen, phosphorus, potassium and sulphur is predominant. Under this situation integrated nutrient management is a better approach for supplying nutrition to the crop by including organic and inorganic sources of nutrients. Inorganic fertilisers, organic manure, biofertilizers, and biostimulants have been demonstrated to be effective in increasing soil nutrient status as well as sustaining higher crop productivity and providing stability (Singh *et al*. 2007; Deshmukh *et al*., 2002).

In sesame, poultry manure has been identified as the most desirable organic manure. By supplying N and P as well as micronutrients, it increases soil fertility and improves moisture and nutrient retention (Farhad*et al*., 2009).Application of biofertilizer, an economical and environmentally friendly input that complements organic and inorganic fertilizers and plays a vital role in plant nutrition. The crops received nitrogen and phosphorous from the application of biofertilizers like Azotobacter, Phosphorous Solubilizing Bacteria, and pseudomonas fluorescens, respectively. The Nitrogen is the most important plant nutrient obtained from biofertilizers helps in crop productivity and plant growth. The ability to fix atmosphere nitrogen is a vital physiological characteristic of *Azotobacter*. *Azotobacter* cells are typically absent from the surface of the roots but are prevalent in the rhizosphere and protects the roots against other soil-borne diseases.(Lali *et al.,* 2020).The combination of micro and macronutrients, amino acids, carbohydrates, and plant growth regulators in seaweed extract helps plant to absorb more nutrients from the soil, which increases in sesame yields(Kavipriya*et al.,* 2011). In light of the above reasons, the present investigation was undertaken to study the impact of collated use of inorganic NPK fertilizers, poultry manure, biofertilizers and seaweed extract on soil nutrient status of gingelly grown soil.

MATERIALS AND METHOD

A field experiment was carried out in a farmer's field during April- June, 2022 at Vallampadugai village, to find out the impact of collated use of inorganic NPK fertilizers, poultry manure, biofertilizers and seaweed extract on soil nutrient status of gingelly grown soil. The various treatments included were T_1 - 100% recommended dose of fertilizers 35:23:23 N, P_2O_5 K_2O kg ha^{-1}, T_2 – poultry manure @ 10 t ha^{-1} , T_3 - 50% RDF + poultry manure @ 10 t ha^{-1}, T_4 - 75% RDF + poultry manure @ 10 t ha^{-1}, T_5- poultry manure @ 10 t ha^{-1} + biofertilizer consortium, T_6 - 50% RDF + poultry manure @ 10 t ha^{-1}+ biofertilizer consortium, T_7 - 75% RDF + poultry manure @ 10 t ha^{-1} + biofertilizer consortium, T_8– poultry manure @ 10 t ha^{-1} +seaweed extract @15%, T_9 - 50% RDF + poultry manure @ 10 t ha^{-1}+ seaweed extract @15%, T_{10} - 75% RDF + poultry manure @ 10 t ha^{-1} + seaweed extract @ 15%. The above treatments were arranged in a Randomized Block Design and replicated thrice, using sesame variety VRI 2. The experimental soil had sandy texture with pH- 7.48; EC- 0.74 dSm^{-1}, organic carbon- 3.21 g kg^{-1}, available N- 216.2 kg ha^{-1}, phosphorus- 13.8 kg ha^{-1}, potassium- 277.3 kg ha^{-1}, sulphur – 7.9 mg kg^{-1}, exchangeable calcium- 8.21 (c mol (p+) kg^{-1}) and magnesium – 5.89 (c mol (p+) kg^{-1}). Calculated amount of inorganic fertilizer doses of nitrogen (35 kg N ha^{-1}), phosphorus (23 kg P_2O_5 ha^{-1}) and potassium (23 kg K_2O ha^{-1}) were applied through urea, DAP and muriate of potash, respectively. Half of the N and entire P_2O_5 and K_2O were applied as basal and the remaining half dose of N was applied in two splits at flowering and capsule formation stage. Poultry manure and biofertilizer consortium (*Azospirillum, Phosphobacteria* and *Pesudomonas fluorescens)* were applied basally and well incorporated into the soil as

per the treatment schedule. Foliar application of seaweed extract @ 15%was applied at 30 and 60 DAS as per the treatment. The soil samples were collected at 30, 60 DAS and at harvest stage. The samples were analysed for available N, P, K,S and exchangeable Ca and Mg.

RESULT AND DISCUSSION

Available Nitrogen

The data given in Table 1 revealed that the application of integrated nutrient management treatments significantly influenced the available nitrogen content in soil. Significantly the highest available soil N was found under the treatment (T_7) 75% RDF + poultry manure @ 10 t ha^{-1} + biofertilizer consortium which recorded the value of 327.70 kg ha^{-1} at 30 DAS, 292.64 kg ha^{-1} at 60 DAS and 273.46 kg ha^{-1} at harvest stage. This was followed by treatments T_{10} and T_4. The treatment (T_{10}) 75% RDF + poultry manure @ 10 t ha^{-1} + seaweed extract @ 15% was found to be on par with (T_4) 75% RDF + poultry manure @ 10 t ha^{-1} which received available N content of 313.15, 279.17 and 261.97 kg ha^{-1} at 30, 60 DAS and at harvest stage, respectively. T_1, T_6, T_9, T_3, T_5 and T_8 were next in order. However, the treatments T_9 andT_3; T_8 and T_2 were found to be on par. The lowest available nitrogen was found under the treatment (T_2) poultry manure @ 10 t ha^{-1} which registered the value of 249.45, 218.94 and 208.74 kg ha^{-1} at 30, 60 DAS and at harvest stage. respectively. T_9, T_6, T_3, T_8 and T_5 were next in order. The lowest available nitrogen was found under the application of poultry manure @ 10 t ha^{-1} which registered the value of 245.20, 218.94 and 202.19 kg ha^{-1} at 30, 60 DAS and at harvest stage. This can be a result of enhanced N availability in the soil brought by the application of inorganic fertilizers coupled with organic manures. (Sahu*et al.,* 2017). Initial crop demand is maintained by inorganic sources, but later stages have contributed by organic sources due to their slower release of nutrients. The increase in available nitrogen could be attributed to the direct addition of nitrogen through inorganic fertilizers, poultry manure and the proliferation of soil microbes through *Azospirillum*, which could convert organically bound nitrogen to inorganic form to the available nitrogen pool of the soil and *Azospirillum,* helps to fix the atmospheric nitrogen in to the soil, thus increasing the available nitrogen status. (Sarangthem *et al.,* 2011).

Available Phosphorus

An appraisal of data presented in Table 1 revealed that application of inorganic fertilizers, organic manure, biofertilizers and seaweed extract have significant influence on available phosphorus content in soil. Among the various treatments, the highest amount of available phosphorus content 23.70 kg ha^{-1} at 30 DAS, 20.42 kg ha^{-1} at 60 DAS and 18.51 kg ha^{-1} at harvest stage were recorded with the combined application of 75% RDF + poultry manure @ 10 t ha^{-1} + biofertilizer consortium (T_7). This was followed by the treatments T_{10} - (75% RDF + poultry manure @ 10 t ha^{-1} + seaweed extract @ 15%)and T_4 (75% RDF + poultry manure @ 10 t ha^{-1}). The treatment T_{10} was statistically on par with T_4 which registered 22.52, 19.23 and 17.50 kg ha^{-1} at 30, 60 DAS and at harvest stage, respectively. This was followed by the treatments significantly arranged in the descending order as T_1> T_6>T_9>T_3>T_5 and T_8. However, the treatments T_9 andT_3; T_8 and T_2 were found to be on par. Application of poultry manure @ 10 t ha^{-1} (T_2) recorded a comparatively lower available P content of 17.31 kgha^{-1} at 30 DAS, 14.25 kg ha^{-1} at 60 DAS and 12.82 kg ha^{-1} at harveststage. This might be the result of the addition of poultry manure along with PSB, which created favourable conditions for microbial and chemical activity, improved water retention capacity and CEC of soil resulted in prolific root development and added organic matter to the soil, which in turn formed more stable available P. Similar findings were also reported by Basu*et al.* (2006) and Kumar (2014).

Available potassium

The data presented in Table 1 indicated that the application of various integrated nutrient management treatment did not show significant effect on available potassium content in soil but numerically higher available K content of soil 394.22 kg ha^{-1} at 30 DAS, 374.63 kg ha^{-1} at 60 DAS and 349.34 kg ha^{-1} at harvest stage was obtained with an application of 75% RDF + poultry manure @ 10 t ha^{-1} + biofertilizer consortium (T_7). This was followed by the treatments T_{10} (75% RDF + poultry manure @ 10 t ha^{-1} + seaweed extract @ 15%) and T_4 (75% RDF + poultry manure @ 10 t ha^{-1}). The treatment T_{10} was equally efficacious with T_4 (75% RDF + poultry manure @ 10 t ha^{-1}) which received

available K content of 377.87, 358.52, 332.24 kg ha^{-1} at 30, 60 DAS and at harvest stage. The treatments next in order were T_1 (100 % RDF), T_6 (50% RDF + poultry manure @ 10 t ha^{-1}+ biofertilizer consortium), T_9 (50% RDF + poultry manure @ 10 t ha^{-1}+ seaweed extract @15%), T_3 (50% RDF + poultry manure @ 10 t ha^{-1}), T_5 (poultry manure @ 10 t ha^{-1} + biofertilizer consortium) and T_8 (poultry manure @ 10 t ha^{-1} + sea weed extract @ 15%). The lowest available K content in soil was found under application of poultry manure @ 10 t ha^{-1} (T_2) which recorded 306.79 kg ha^{-1} at 30 DAS, 286.61 kg ha^{-1} at 60 DAS and 262.48 kg ha^{-1} at harvest stage. Aside from direct application of potassium through inorganic fertilizers to the available K pool of the soil, the beneficial effects of inorganic fertilisers, poultry manure, and biofertilizers on available K might be attributed to the reduction of K fixation and release due to the interaction of organic matter present in the organic manure with clay. This demonstrates that under the presence of the treatments, transformation reactions occurred that increased the amount of potassium available in the soil, which in turn caused it to be quickly absorbed and better utilised by the plant (Sharanbhoopal, 2010).This result in line of finding by Chetri*et al.,* 2012 who reported that application of poultry manure in large amounts and their subsequent delayed mineralization led to a gradual increase in the amount of available K in soil.

Available sulphur

The positive influence of different combination of inorganic fertilizers, organic manure, biofertilizers and seaweed extract were significantly increasing the availability of sulphur in soil was well evidenced in the present study (Table 2). The highest available sulphur content of 15.62 mg kg^{-1} at 30 DAS, 13.44 mg kg^{-1} at 60 DAS and 12.23 mg kg^{-1} at harvest stage was recorded with the combined application of 75% RDF + poultry manure @ 10 t ha^{-1} + biofertilizer consortium (T_7). This was followed by T_{10} (75% RDF + poultry manure @ 10 t ha^{-1} + sea weed extract @ 15%) and T_4 (75% RDF + poultry manure @ 10 t ha^{-1}). The treatment T_{10} was equally efficient with T_4 which recorded available S content of 14.68, 12.79 and 11.65 mg kg^{-1} at 30, 60 DAS and at harvest stage, respectively. T_1, T_6, T_9, T_3 , T_5 and T_8 were next in order with T_4. The treatment (T_2) poultry manure @ 10 t ha^{-1} registered the lowest available S of 11.32 mg kg^{-1} at 30 DAS, 10.07 mg kg^{-1} at 60 DAS and 8.86 mg kg^{-1} at harvest stage. While poultry manure and inorganic fertiliser were applied together, the nutrients remained slowly and steadily delivered to the plant for a long time, thus increasing the availability of S in the soil (Poonkodi*et al.,* 2018).

Exchangeable calcium

Data presented in Table 2 explicit that significantly the highest exchangeable calcium was registered with 75% RDF + poultry manure @ 10 t ha^{-1} + biofertilizer consortium (T_7) which recorded exchangeable Ca content of 12.41 (c mol (p+) kg^{-1}) at 30 DAS, 11.23 (c mol (p+) kg^{-1}) at 60 DAS and 9.71 (c mol (p+) kg^{-1}) at harvest stage. This was followed by treatments T_6 (50% RDF + poultry manure @ 10 t ha^{-1} + biofertilizer consortium) and T_{10} (75% RDF + poultry manure @ 10 t ha^{-1}+ seaweed extract @15%). However, the treatment T_6 was on par with T_{10} (75% RDF + poultry manure @ 10 t ha^{-1} + seaweed extract @ 15%). The treatment T_{10} registered exchangeable calcium content of 11.86, 10.72 and 9.29 (c mol (p+) kg^{-1}) at 30, 60 DAS and at harvest stage, respectively. The treatment T_{10} was followed by the treatments significantly arranged in the descending order as T_4> T_5>T_9>T_3>T_8 and T_2. However, the treatments T_5 andT_9 was found to be on par. The lowest exchangeable Ca content was recorded with T_1 (100% RDF) which recorded 8.78, 8.18 and 6.75 (c mol (p+) kg^{-1}) at 30, 60 DAS and at harvest stage, respectively. The treatment T_1 was followed by the treatments significantly arranged in the descending order as T_9>T_6>T_3>T_8> and T_5. The lowest exchangeable Ca content was recorded with T_2 (poultry manure @ 10 t ha^{-1}) which recorded 8.98, 8.04 and 6.87 (c mol (p+) kg^{-1}) at 30, 60 DAS and at harvest stage, respectively. This might be because of poultry manure contains a larger percentage of calcium than other organic manures, which helps to enhance the pH of the soil and the amount of exchangeable calcium in the soil. Thus, it was discovered that integrated application was successful in boosting the soil's exchangeable calcium(Vinod Kumar, 2016 and Gokul *et al.,*2021).

Exchangeable magnesium

The data given in Table 2 revealed that the application of integrated nutrient management treatments significantly influenced the exchangeable magnesium content in soil. Significantly the highest exchangeable Mg content was found under the treatment (T_7) 75% RDF + poultry manure @ 10 t ha^{-1} + biofertilizer consortium which recorded the value of 8.25 (c mol (p+) kg^{-1}) at 30 DAS, 7.12 (c mol (p+) kg^{-1}) at 60 DAS and 6.47 (c mol (p+) kg^{-1}) at harvest stage.

This was followed by treatments T_6 and T_{10}. The treatment T_6 (50% RDF + poultry manure @ 10 t ha^{-1} + biofertilizer consortium) was found to be on par with T_{10} (75% RDF + poultry manure @ 10 t ha^{-1} + seaweed extract @ 15%) which received exchangeable Mg content of 7.86, 6.81 and 6.18 (c mol (p+) kg^{-1}) at 30, 60 DAS and at harvest stage, respectively. T_4, T_5, T_9, T_3, T_8 and T_2 were next in order. However, the treatment T_5 and T_9 was statistically on par with each other which registered the value of 7.18, 6.24 and 5.65 (c mol (p+) kg^{-1}) at 30, 60 DAS and at harvest stage, respectively. The lowest exchangeable Mg content was found under the application of poultry manure @ 10 t ha^{-1} + seaweed extract @ 15% which registered the value of 6.17, 5.28 and 4.80 (c mol (p+) kg^{-1}) at 30, 60 DAS and at harvest stage. It is possible that magnesium was liberated from soil exchangeable sites by the organic acids generated during the breakdown of poultry manure. The present findings are in close agreement with Muthuraja*et al*. (2005) and Chattoo*et al.* (2011).

CONCLUSION

On the basis of the above results, it can be concluded that the beneficial effect of inorganic fertilizers, organic manure, biofertilizers and seaweed extract were increasing the nutrient status in the sandy loam soil. Application of 75 % RDF + poultry manure @ 10 t ha^{-1} **+** seaweed extract @ 15%was identified as the best combination treatment which recorded the highest availability of macro and secondary nutrient in the gingelly grown soil.

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Table 1: Effect of inorganic fertilizers, organic manure, biofertilizers and seaweed extract on soil nutrient availability in gingelly

Treatment Details	Available Nitrogen (kg ha^{-1})			Available Phosphorus (kg ha^{-1})			Available Potassium (kg ha^{-1})		
	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest
T_1- (100 % RDF) 35:23:23 N, P_2O_5, K_2O kg ha^{-1}	302.05	268.14	252.71	21.60	18.31	16.59	366.82	346.16	318.88
T_2- Poultry manure @ 10 t ha^{-1}	249.45	218.94	208.74	17.31	14.25	12.82	306.79	286.61	262.48
T_3-50% RDF + Poultry manure @ 10 t ha^{-1}	277.28	245.05	232.89	19.59	16.43	14.65	336.87	319.19	291.22
T_4-75% RDF + Poultry manure @ 10 t ha^{-1}	313.15	279.17	261.97	22.52	19.23	17.50	377.87	358.52	332.24
T_5-Poultry manure @ 10 t ha^{-1} + Biofertilizer consortium	265.98	235.40	223.79	18.67	15.59	13.93	325.84	306.64	280.86
T_6- 50% RDF + Poultry manure @ 10 t ha^{-1} + Biofertilizer consortium	292.42	257.78	244.35	20.79	17.49	15.76	354.79	334.54	307.65
T_7- 75% RDF + Poultry manure @ 10 t ha^{-1} + Biofertilizer consortium	327.70	292.62	273.46	23.70	20.42	18.51	394.22	374.63	349.34
T_8-Poultry manure @ 10 t ha^{-1} + Seaweed Extract @15%	255.68	224.10	212.77	17.77	14.67	13.13	313.36	293.41	267.84
T_9- 50% RDF + Poultry manure @ 10 t ha^{-1} + Seaweed Extract @ 15%	282.28	248.67	236.99	20.00	16.77	14.87	342.83	323.31	296.45
T_{10}- 75% RDF + Poultry manure @ 10 t ha^{-1} + Seaweed Extract @ 15%	317.47	283.39	265.23	22.88	19.55	17.71	382.23	363.15	338.47
SEd	**4.08**	**3.62**	**3.39**	**0.29**	**0.25**	**0.22**	**4.90**	**4.65**	**4.34**
CD (p=0.05)	**8.23**	**7.34**	**6.85**	**0.61**	**0.53**	**0.47**	**9.87**	**9.38**	**8.74**

Table 2: Effect of inorganic fertilizers, organic manure, biofertilizers and seaweed extract on soil nutrient availability in gingelly

Treatment Details	Available Sulphur (mg kg^{-1})			Exchangeable Calcium (c mol (p+) kg^{-1})			Exchangeable Magnesium (c mol (p+) kg^{-1})		
	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest
T_1- (100 % RDF) 35:23:23 N, P_2O_5, K_2O kg ha^{-1}	13.97	12.66	11.14	8.78	8.18	6.75	6.07	5.17	4.68
T_2- Poultry manure @ 10 t ha^{-1}	11.32	10.07	8.86	9.30	8.60	7.07	6.33	5.41	4.92
T_3-50% RDF + Poultry manure @ 10 t ha^{-1}	12.50	11.33	9.87	10.25	9.39	7.99	6.92	5.94	5.42
T_4-75% RDF + Poultry manure @ 10 t ha^{-1}	14.68	12.72	11.65	11.46	10.31	8.88	7.57	6.58	5.93
T_5-Poultry manure @ 10 t ha^{-1} + Biofertilizer consortium	11.94	10.82	9.46	10.92	9.95	8.46	7.30	6.32	5.70
T_6- 50% RDF + Poultry manure @ 10 t ha^{-1} + Biofertilizer consortium	13.34	12.15	10.55	11.99	10.85	9.41	7.97	6.89	6.26
T_7- 75% RDF + Poultry manure @ 10 t ha^{-1} + Biofertilizer consortium	15.62	13.44	12.23	12.41	11.23	9.71	8.25	7.12	6.47
T_8-Poultry manure @ 10 t ha^{-1} + Seaweed Extract @15%	11.43	10.33	9.03	9.76	9.03	7.60	6.65	5.70	5.23

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RESEARCH ARTICLE

Comparison of Stress, Anxiety and Depression at Different age Levels Among School Children of NCR Region During Covid-19 Pandemic

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ABSTRACT

The purpose of the current study was to compare depression, anxiety and stress at different age levelsduring the COVID-19 pandemic among school children inthe national capital region of India. A sample of three hundred schoolboys was randomly selected for the present study with ages ranging between 14 to 18 years. Further, all the subjects were divided into three groups i.e. below 15 years, between 15 to 17 years and above 17 years and each group had 100 subjects. All the subjects voluntarily took part in the study and a detailed procedure was informed to them. A written consent form was signed by the administrators of each school. DASS-21 questionnaire was used to measure stress, anxiety and depression which is developed by Lovibond, P.F.; Lovibond, S.H. (1995).The One Way ANOVA was used as a statistical technique and the result of the study showeda significant differencein depression (F = 8.64; p < .000),anxiety (F = 26.01; p < .000),and stress (F = 15.35; p < .000).LSD post hoc analysis showed thatmean scores for depression, anxiety and stress were statistically significantly different between those below 15 years and above 17 years (p < .000) and 15-17 years and above 17 years (p < .003); but not between below 15 years and 15-17 years (p = .342). From the above results it may be concluded thatabove 17 years students are more prone to depression, anxiety and stress in comparison to those below 15 years and between 15 to 17 years.They were tenser due to restrictions of movements, home isolation and ambiguity about their career, and pressure on academic performance. Great pressure to provide academic excellence, can be the probable cause for a disturbed state of mind.

Keywords: COVID-19, Stress, Depression, Anxiety, DASS-21 scale

INTRODUCTION

The COVID-19 pandemic has rapidly spread in most countries and brought unexpected health, economic, social, educational, and psychological consequences (Liu et al., 2020;Pfefferbaum& North, 2020;Radwan & Radwan, 2020).During the current pandemic, the psychological status of the school students was strongly affected due to the closing of schools and other educational consequences resulting from this sudden closure.During a health crisis, people tend to suffer the panic and stress of being infected with the disease resulting in depression, stress and anxiety(Bakioğlu et al., 2020;Rehman et al., 2020;Yang et al., 2020).Thakur (2020)&Gazmararian et al., (2021) showed that the COVID-19 pandemic has had a negative psychological effect on school students, and reported the prevalence of anxiety, depression, and stress among students. Depression is a common psychiatric disorder that presents with depressed mood, loss of interest or pleasure, feeling of guilt or low-self –worth, disturbed sleep or appetite, low energy and poor concentration(Otorkpa, 2022). Anxiety is defined as an emotional reaction or state of stress that occurs before examinations and continues through the examination period(Russ et al., 2012).Stress is the nonspecific response of the body to any demand.Stress is the most often an over physical reaction or defensive outbursts, rocking and self-comforting behaviours, headache, and stomach ache, nervous fine motor behaviors(Sahoo&Khess, 2010).Preventive and control procedures have been adopted to stop the widespread COVID-19. Despite the importance of these procedures, they have long and short term consequences for the well-being and mental health of the school-going children(Radwan et al., 2020).These negative impacts may translate into unhealthy behaviours (e.g. excessive substance use), emotional reactions (e.g. depression, distress, anxiety, fear, etc.), and non-compliance with the public health procedures (e.g. home quarantine and confinement, and vaccination) in the school-going children.(Gao et al., 2020)..Depression, anxiety and stress affect many teenagers and often go unnoticed and untreated. These states silently affect their academic performance, and family lives and rob them of their self-image(Chokshi et al., 2021).Because school closure was implemented in India during the COVID-19 period, distress experienced (stress, anxiety and depression) by school students during the COVID-19 pandemic has not been previously investigated in India. Therefore, the present study aimed to compare depression, anxiety and stress at different age levels among school students during the time of lockdown period. This study is the first attempt of its kind to fill the sensitive gap and help policymakers in the management of students' mental health.

METHODOLOGY

Study design and Setting

Researchers conducted a cross-sectional survey which involves three hundred school children from National Capital Region (Delhi, Gurugram, Sonepat and Noida). A purposive sampling technique was used to collect data and data was collected between July 2020 to September 2020 during the peak of the first wave of the Covid-19 pandemic. Students were attending classes through the virtual platform as, during this time colleges, and universities were closed.

Participants

A sample of three hundred schoolboys were randomly selected for the present study with ages ranging between 14 to 18 years. Further, all the subjects were divided into three groups i.e. below 15 years (100 boys), between 15 to 17 years (100 boys), and above 17 years (100 boys) each group had 100 subjects. All the subjects voluntarily took part in the study and a detailed procedure was informed to them. A written consent form was signed by the administrators of each school.

Tools

DASS-21 questionnaire was used to measure stress, anxiety and depression which is developed by Lovibond, P.F.; Lovibond, S.H. (1995).

Statistical Analysis

Google form was used to collect data and transfer it to a Microsoft Excel sheet. SPSS version 22 was used to analyse the data, and One-Way ANOVA was applied for analyzing the scores of stress, anxiety and depression. A *p-value* of less than 0.05 was taken for statistical significance. LSD post hoc analysis was used as the F value was significant.

RESULTS

To compare stress, anxiety and depression at different age levels among school-going children of the NCR regionof India during Covid -19 pandemic of India One – Way ANOVA was used at 0.05 levels and the following results were obtained: Table -1 indicates that depression was highest in the age group above 17years and lowest in the below15years age group. Anxiety was highest in the age group above 17years and lowest in the below 15years age group. Stress was highest in the age group above 17years and lowest in the below15 years age group respectively. The same can be seen in figure-1. Table 2 shows statistically significant difference on depression ($F = 8.64$; $p < .000$),anxiety ($F = 26.01$; $p < .000$),and stress ($F = 15.35$; $p < .000$), hence null hypothesis may be rejected at 0.05 level.Table 3 shows that for mean scores fordepression were statistically significantly different between below 15 years and above 17 years ($p < .000$) and 15-17 years and above 17 years($p < .003$); but not between below 15 yearsand 15-17 years ($p = .342$).Mean scores for anxiety were statistically significantly different between below 15 years and above 17 years ($p < .000$) and 15-17 years and above 17 years ($p < .000$); but not between below 15 years and 15-17 years ($p = .105$). Mean scores for stress were statistically significantly different between below 15 years and above 17 years ($p < .000$) and 15-17 years and 17 years ($p < .003$); but not between below 15 years and 15-17 years ($p = .499$).

DISCUSSION OF FINDINGS

The main objective of this study was to comparethe occurrence of depression, anxiety and stress in school-going children inthe NCR region of India at different age levels. This study was carried out on the school-going children of the NCR region of India and as per Table 1, it was found that the mean scores of the DASS-21 scale were greater in above 17 years students than in below 15 years and between 15-17 years students. The present study observed that the prevalence of depression, anxiety and stress was more in above 17 years of school-going childrenwhen compared to below 15 years and between 15-17 years school going children respectively.The key reason for this seems to be that above 17 years of school-going childrenare frequently using social media platforms, so they have a greater opportunity to obtain information concerning COVID-19, which causes fear, panic, stress, anxiety, and depression due to the spread of rumours, fabricated news, and misinformation about COVID-19. Also, above 17 years of school-going children are concerned about the consequences caused by this crisis on their educational achievements due to the closing of schools during the COVID-19 pandemic(Cheng et al., 2014). Above 17 years of school students may be more aware of the danger of infecting with COVID-19 and have a more realistic perception of the events caused by this pandemic, so their stress and anxiety were greater. After 15 yearsof school, students are not aware of the current health crisis and do not have sufficient awareness of the risk of infection with COVID-19, so they had less depression, stress and anxiety. The authors confirmed that some lower age group students considered themselves on a vacation and they are doing daily activities as usual such as playing on roads, going to picnics and attending social events during the COVID-19 lockdown. This study also highlights how school students have suffered during the time of quarantine due to the COVID19 pandemic (Cao et al., 2020;Sahu, 2020), where secondary school students reported moderate stress and severe anxiety. This result could be attributed to the closure of schools, where the students shifted from traditional learning to E-learning, therefore the academic performance of students was significantly affected, particularly those students who have limited access to the internet or students who do have not a mobile phone. In contrast, students were found to be depressed to a moderate level which might contribute to changes in their lifestyle and daily activities, and in their learning activities(Radwan et al., 2021).

CONCLUSIONS

All the education institutions are badly affected by the novel coronavirus pandemic and students were vulnerable to the stressful environment created due to the uncertainty of opening and closing schools.The present study concludes that above 17 years students are more prone to depression, anxiety and stress in comparison to younger age groups.They were tenser due to restriction of movements, home isolation and ambiguity about their career, the pressure of academic performanceGreat pressure to provide academic excellence, which can be the probable cause for a disturbed state of mind.

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Table 1: Descriptive Statistics

		N	Mean	Std. Deviation
Depression	below 15 years	100	3.140	2.574
	15-17 years	100	3.570	3.153
	Above 17 years	100	4.940	3.755
	Total	300	3.883	3.278
Anxiety	below 15 years	100	2.820	2.181
	15-17 years	100	3.510	2.897
	Above 17 years	100	5.750	3.729
	Total	300	4.027	3.245
Stress	below 15 years	100	4.420	3.188
	15-17 years	100	4.100	2.721
	Above 17 years	100	6.510	3.989
	Total	300	5.010	3.497

Table 2: ANOVA forDepression Anxiety and Stress of Different Age Groups

		Sum of Squares	df	Mean Square	F	p-value.
Depression	Between Groups	176.72	2	88.363	8.644*	.000
	Within Groups	3036.19	297	10.223		
	Total	3212.91	299			
Anxiety	Between Groups	469.28	2	234.643	26.018*	.000
	Within Groups	2678.50	297	9.019		
	Total	3147.78	299			
Stress	Between Groups	342.62	2	171.310	15.351*	.000
	Within Groups	3314.35	297	11.159		
	Total	3656.97	299			

***Significant at 0.05 level**

Table 3: LSD post hoc test for multiple comparisons

Dependent Variable	(I)	(J)	Mean Difference (I-J)	Std. Error	Sig.
Depression	below 15 years	15-17 years	-.430	.452	.342
		above 17 years	-1.800*	.452	.000
	15-17 years	below 15 years	.430	.452	.342
		above 17 years	-1.370*	.452	.003
	above 17 years	below 15 years	1.800*	.452	.000
		15-17 years	1.370*	.452	.003
Anxiety	below 15 years	15-17 years	-.690	.425	.105
		above 17 years	-2.930*	.425	.000
	15-17 years	below 15 years	.690	.425	.105
		above 17 years	-2.240*	.425	.000
	above 17 years	below 15 years	2.930*	.425	.000
		15-17 years	2.240*	.425	.000
Stress	below 15 years	15-17 years	.320	.472	.499
		above 17 years	-2.090*	.472	.000
	15-17 years	below 15 years	-.320	.472	.499
		above 17 years	-2.410*	.472	.000
	above 17 years	below 15 years	2.090*	.472	.000
		15-17 years	2.410*	.472	.000

***. The mean difference is significant at the 0.05 level.**

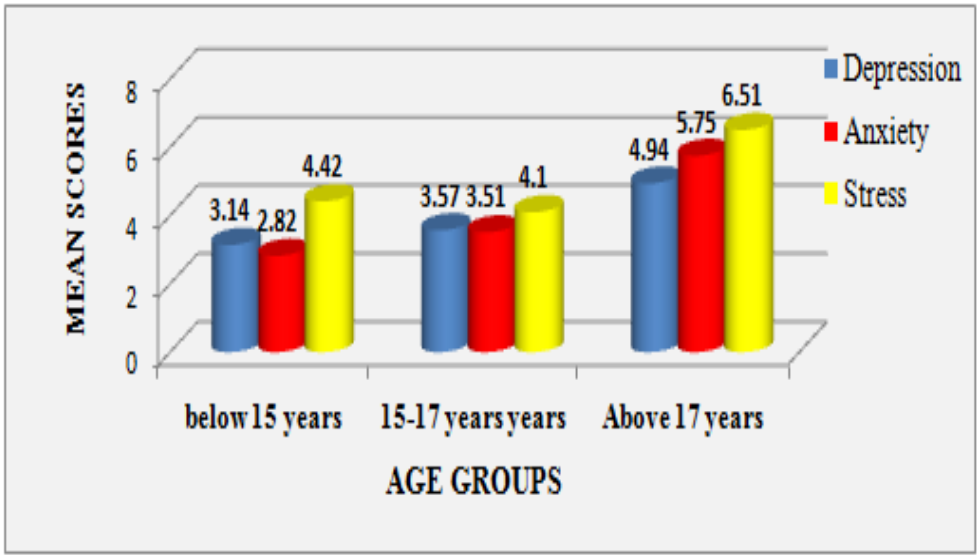

Fig 1: Graphical Representationof Depression, Anxiety and Stress of Different Age Groups

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RESEARCH ARTICLE

Comparison of ResNet 50 and Custom CNN Classifiers for the Detection and Classification of Nutrient Deficiency in Cotton

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ABSTRACT

Symptoms of nutrient deficiency in plants generally arises in poorly fertile soils that can affect plant growth and yield, if it is not treated at the early stage. So for, deficiency identification is carried out manually which needs through subject knowledge and trained personal especially for large area. With rapid development of technology, it is possible to build a system via smartphone to detect the nutrient deficiency of plants. In this paper, we compared the performance custom CNN with ResNet50 for the diagnosis of nutrient deficiency in cotton. ResNet architecture with transfer learning is applied in the experiments and is compared with custom CNN. We trained the model further with image of cotton plants. The dataset consists of 2000 images for the training process and 500 images for Validation. Image augmentation method is also used to increase the variation of the dataset. The experimental results show that ResNet50 achieves the higher accuracy 97% as compared to custom CNN, which recorded the lower accuracy of 70% in the identification nutrient deficiency symptoms in cotton

Keywords: Cotton, Macro nutrient deficiency, Machine learning, deep Learning, Custom CNN, ResNet50

INTRODUCTION

Cotton (*Gossypium hirsutum*) is the major commercial crop grown in India. Generally, cotton crop are grown in low in organic carbon and available nutrient status soils, consequently resulting in nutrient deficiency and low productivity. Presently, the cotton growers of India apply blanket recommendation of fertilizers which are far below

the soil test based recommended rates (Blaise, Bonde, and Choudhary 2005). Due to low availability of organic manures and continuous application of NPK fertilizer alone over the years have led to macro and micronutrient deficiency in cotton and considerably reduced the yield. Farmers are getting low profit due to the imbalanced fertilization

Diagnosis of nutrient deficiencies in cotton is an integral part of scientific fertilization, because soils often fail to meet out the nutrient demands of growing cotton plants. Determination of the needed nutrients will facilitate the formulation of a fertilization programme to supply the target nutrients without oversupplying others. Symptoms of a nutrient deficiency in cotton are manifestations of malnutrition in the crop; they can be visually inspected from the plant morphology and thereby provide enough information to diagnose the nutrient deficiency. Problems arise as soils are over exploited, and many nutrient deficiencies are widely distributed both across a farm or region and in time throughout the growing season. It is therefore a challenge for agricultural experts to properly diagnose symptom and effectively correct it in time.

In addition to manual diagnosis, chemical and nondestructive analytical methods have been used to identify nutrient deficiencies in crops. Chemical diagnoses can be classified as either full-scale analysis or rapid tissue measurement (Ata-Ul-Karim et al., 2016). Full-scale analysis measures the contents of nutrient elements in a crop. This diagnostic technique can determine all the nutrient elements essential to a plant's survival and those involved in its growth (Xiong et al., 2019). The results are precise and reliable and usually provide sufficient data for diagnosis, but the technique involves vast labour costs and is confined to a laboratory. The rapid measurement of unassimilated nutrients in plant tissues is carried out by visual colorimetry, which is fast, straightforward, and generally suitable for field diagnosis. Due to the extensive examination required for deeper analysis, this technique is usually applied to assess deficiencies of major elements such as N, P, and K in crops. The minimal contents of trace elements and the high precision required for their analysis prevent rapid measurement of their status.

Nondestructive diagnosis techniques include *in situ* measurement using a chlorophyll meter, spectral remote sensing, and computer vision. The first two of these methods are costly or complicated in data processing and are suitable only for specific elements. In contrast, computer vision requires only a smartphone for low-cost image acquisition and transfer, making image-based diagnosis potentially the best and most versatile solution. Conventional computer vision methods such as support vector machines (SVMs) have demonstrated their ability to detect nutrient deficiencies of five elements such as N, P, and K in the leaves of rape (Zhang et al 2018) and rice (Chen et al 2017); yet, SVMs run the risk of overfitting large datasets as they are sensitive to outliers. Convolutional neural networks (CNNs) are attractive machine learning tools (LeCun., 2015), and since the success of deep CNNs (DCNNs) in the ImageNet Large Scale Visual Recognition Challenge 2012 (ILSVRC 2012), they have become the preferred choice for image recognition. However, the use of DCNNs to identify nutrient deficiencies in cotton has rarely been reported.

Inspired by the Plant Village Project (Hughes and Salathe2015) we explored the accuracy of diagnosing nutrient deficiencies in cotton by processing image data from sand culture experiment, with two different DCNNs as potentially practical solutions for real-time crop assessment.

MATERIALS AND METHODS

Sand culture Experiment

The dataset is the key for fitting a model with good generalization ability. Many studies have utilized the Plant Village dataset, which is based on expert knowledge as some of the observed nutrient deficiency symptoms and diseases can be directly identified by visual cues. Although the symptoms of nutrient deficiencies in cotton are similar universally, a challenge remains in collecting images in the field covering all the deficiency types. Here, we designed a sand culture experiment to collect images for 10 classes of nutrient deficiencies (N, P, K, Ca, Mg, S, Fe,

Mn, Zn, and B, each denoted by a minus sign followed by its chemical symbol, e.g., –N) and contrast them with cotton plants under full nutrition, making a total of 11 classes. The sand culture experiment was conducted with cotton ((*Gossypium hirsutum* L.) var LRA 5166) the major local variety in Cuddalore region of Tamilnadu. We designed the experiment as a single-factor test with three replications. Eleven nutrient solutions (pH 5.0–5.5) were prepared separately. The contents of full-strength Hogland nutrient solution and 10 deficiency solutions are used as treatments in the study. Each treatment was performed in a 10kg plastic pot. Pre cleaned and washed silica sand was filled in the pots. Two seeds were sown in each pot, after germination, one seedling was maintained in each pot, the plants are maintained till the development of deficiency symptoms

Dataset

The symptoms of nutrient deficiencies manifested during the sand culture experiments are recorded using moble camera. The morphological symptoms of cotton plants differed among the 11 classes due to the nutrients having various physiological functions in the plant system. For example, Ca, Mg, Fe, Mn, and Zn are directly or indirectly related to chlorophyll formation and/or photosynthesis, and therefore their deficiencies result in chlorosis. As P is associated with carbohydrate metabolism, its deficiency results in carbohydrate retention in the leaves and thus purple-red coloration developing in the stems and leaves due to the formation of anthocyanins. The symptoms of nutrient deficiencies were also influenced by the mobility of the nutrients in the plant system. Mobile elements such as N, P, K, and Mg, when deficient, tend to move quickly toward the younger parts of the plant, making symptoms always appear first in older parts such as the lower leaves. Conversely, deficiencies of less mobile elements such as Ca and Fe often manifest in the younger parts of the plant.

Mobile phones captured images from plants leaves at different time points depending on the location and progress of the symptoms. Before photography, the deficiency symptom must be at least minimally recognizable, and the minimum recognized unit of the symptom was used as the image framing center, the images of cotton leaves included complex backgrounds; they were given one of 11 class labels according to the assigned nutrient deficiency. The images were cropped to ensure that the symptoms appeared prominently and therefore reduce memory usage for better calculation performance. Because the time points of different deficiency symptoms are inconsistent, data collection cannot guarantee the balance of each class throughout the experimental period.

The figure 1 shows the proposed architecture diagram. The plant leaf images, both healthy and affected at multiple stages (early and later stages) are acquired through mobile camera. After data collection, the next step is to perform the image augmentation, which include rotation, re-scaling, zooming, horizontal flip, width shift, and height shift. Further, we performed image processing steps renaming and resizing, and new sample images were generated to enrich the dataset. Next, the samples data is labeled with the help of expert knowledge. The labeled sample data is then used during the training phase of the selected deep learning algorithm. Finally, we identify and classify the nutrient deficiency and the results are compared and evaluated to identify the appropriate algorithm for a given situation.

Data Augmentation

Data augmentation is a method of creating new training data from previous training data. We apply domain-specific techniques to samples from the training data to generate unique and distinct training instances. In this research, we augment the images by rescaling, rotating the images, changing the width and height shifts, zooming the images, and doing the horizontal flip. All the images are renamed by python code, resized by the cv2 library, and converted into RGB images for further data processing. The dimensions of the images are (224 x 224 x 3), height and width are 150 and 150, and 3 represents RGB channel (Red, Green, and Blue).

During the training and testing phase, the image input size must be the same as the input size applied to the model (ResNet50 and custom CNN). In this research the image size was adjusted to 224x224 for both the models. Then the pixel value (between 0 and 255) is scaled to the interval [0, 1]. The pixel values are normalized because the deep learning models prefers to handle the smaller input values. Data augmentation is applied during the training

process. This operation can be performed using Keras and Image Data Generator functions by applying conversion operations including rotation, width and height shift, scaling and horizontal flip. Amplification is performed on training data, not on data validation.

Performance Considerations

It is common practice to execute image augmentations on-the-fly during the model training and not pre-compute them ahead of time. Since the datasets for computer vision tasks are typically large in size, this allows one to overcome limitations of the storage space without sacrificing the diversity and amount of image transformations. Many computations in modern deep learning models have been moved to be executed on general-purpose consumer-grade parallel computing chips, such as graphics processing units (GPUs) that have been getting cheaper over the years. However, image augmentations are typically executed on central processing units (CPUs). While a GPU is processing a batch of images, the next batch is being augmented on a CPU using multiprocessing, such that each image is transformed in a separate process. As GPUs are getting faster, execution of image transforms on a CPU can become a performance bottleneck. Thus, to fully utilize the power of modern GPUs, augmentations on CPUs have to be fast enough and the speed of each transform operation is important. Recently, implementations of GPU-based image augmentations have been presented; however, the full advantage of using these approaches can only be achieved in a setup with a relatively high GPU/CPU core ratio. On the software side, although Python has become a lingua franca in the machine learning community, it is well known that the Python interpreter is not very efficient for executing computation-heavy algorithms. In this study uniform image size of 224X224 was used,2000 images were used for training,500 images for validation and 500 images for testing the model.

Classification

Custom CNN

The deep-learning-based techniques, particularly CNNs, are the most promising approach for automatically learning decisive and discriminative features. Deep learning (DL) consists of different convolutional layers that represent learning features from the data. Plant-disease detection can be accomplished using a deep-learning model. Deep learning also has some drawbacks, as it requires large amounts of data to train the network. If an available dataset does not contain enough images, performance is worse. Transfer learning has several advantages; for example, it does not needs a large amount of data to train the network. Transfer learning improves learning a new task through knowledge transfer from a similar task that had already been learned. Many studies used transfer learning in their disease-detection approach. The benefits of using transfer learning are a decrease in training time, generalization error, and computational cost of building a DL model. In this work, we use different DL models to identify plant diseases. The inception module can extract more specific and relevant features as it allows for simultaneous multilevel feature extraction. We replaced the standard convolution of an inception block with depth-wise separable convolution to reduce the parameter number. Multiple feature extraction improves the performance of the model. In a residual network, it has a shortcut connection that basically feeds the previous layer output to the next layer, which strengthens features and improves accuracy. To evaluate performance on a lightweight memory-efficient interface, the Custom CNN model is used. MobileNetV2 architecture can achieve high accuracy rates while keeping parameter number and computation as low as possible. Network depth, width, and resolution can lead to better performance accuracy with fewer parameters. We also used this Efficient Net model to identify diseases in plant and evaluated its performance. In the implemented DL architecture, we used different batch sizes of 32–180 to evaluate performance. Different dropout values and learning rates were also used to examine performance. Several epochs were used to run the model. The evaluation showed that the implemented deep CNN achieved impressive results and better performance in comparison with those of state-of-the-art machine-learning techniques.

Convolutional neural networks became familiar in machine vision since the Custom CNN model was popularized in DL architecture. The development of the Inception model was important in the field of machine vision. Inception is a simple and more powerful DL network with sparsely connected filters, which can replace fully connected network architectures, especially inside convolutional layers. The Inception model's computational efficiency and number of used parameters are much lower in comparison with those of other models such as AlexNet and Custom CNN. An

inception layer consists of differently dized convolutional layers (e.g., 1 x 1, 3 x 3, and n x n convolutional layers) and pooling layers with all outputs integrated together and propagating to the input of the next layer. Instead of using standard convolution in the inception block, we used depth wise separable convolution. The figure 3 shows custom CNN architecture.

ResNet50 Classification

A Residual Neural Network (ResNet) is an Artificial Neural Network (ANN) of a kind that stacks residual blocks on top of each other to form a network. Deep residual nets make use of residual blocks to improve the accuracy of the models. The concept of "skip connections," which lies at the core of the residual blocks, is the strength of this type of neural network. The skip connections add the outputs from previous layers to the outputs of stacked layers, making it possible to train much deeper networks than previously possible. ResNet(He et al., 2016)solves the vanishing gradient problem in deeper networks using shortcut connections where the gradient reaches earlier layers and compositions of features at varying depth can be combined to improve performance. ResNet relies on many stacked residual units that are composed of convolution and pooling layers; it therefore acts as the building block to construct the network. The structure of ResNet consists of residual blocks, each of which is concatenated by three convolutions of 1 × 1, 3 × 3, and 1 × 1 kernels. The residual blocks are then converged by average pooling and classified using the softmax function. A total of 80% of the dataset was used for training and 20% for validation. The ResNet50 utilized the transfer learning by modifying the pre-trained VGGNet 16 for the identification task of plant leaf diseases.

Image Analysis

A fully automatic segmentation method for plant leaf images in a complex background was used for image segmentation. First, we used a vein enhancement and then extraction operation to obtain an accurate foreground marker image. Then, the marker-controlled watershed method was used to realize image segmentation.

A Confusion matrix that depicts the class of each occurrence depending on the classifier methods used, opening the way for various performance indicators to identify the tendency of the system. The parameters of the confusion matrix are based on the number of groups. Actual Class labels are mentioned in columns and predicted in rows. Each cell is classified as True positive, True Negative, False Positive, and False Negative.

RESULTS AND DISCUSSION

The experiments were performed on a Windows10 desktop equipped with one Intel Core i9 7920X CPU with 64 GB RAM, accelerated by two GeForce GTX 1080Ti GPUs with 11 GB memory. The model implementation was powered by the Keras and Image Data Generator functions back end. Model performance was evaluated three times, expressed as the average accuracy of training and validation, and graphically depicted for each model. The Adam optimizer was used to accelerate the training process. Images were resized through Python Image Library to a specific size based on the model requirement. Repeated experiments comparing different learning rates showed that the learning rate of 0.001 was most suitable for the model to run 50 epochs for training, and no decay was used.

Approach Analysis

This study compared two state-of-the-art DCNNs to evaluate the performance of image recognition techniques in identifying nutrient deficiencies in cotton. The custom CNN with 5 layers and, ResNet with 50 layers were effectively fitted(Figure 3). After fine-tuning, The ResNet50 model achieved average training, validation, and test accuracies of over 97%, which was much higher than custom CNN(70%).From the perspective of approach process, ResNet-50showed a slow increase in its test and validation accuracies, which might be due to the huge number of parameters in this model compared with custom CNN. Thus, during back propagation, the pre-trained parameters of ResNet50-Largedata sets were updated slowly to obtain good generalization ability. Moreover, the ResNet50 was able to adequately fit the data, while the custom CNN seemed to give an over fitting. The possible reason is that some of the

labeled images had complex background where the outline data would easily lead to over fitting in the custom CNN. In contrast, theResNet50 approach can synthesize local receptive field in higher-level networks.

Qualitative Analysis

Since ResNet50 performed better than custom CNN in the classification of nutrient deficiency in cotton, one can use this model for qualitative analysis. Three indices were calculated to gain a better understanding of the model's prediction accuracy. The recall refers to the ratio of correctly predicted positive observations to the all observations in an actual class. The precision refers to the ratio of correctly predicted positive observations to the total predicted positive observations. TheF1-score refers to the weighted average of precision and recall, which therefore considers both false positives and false negatives; F1 is usually more useful, especially for an uneven class distribution, albeit not as intuitively understandable as accuracy. Table 6 gives the good prediction results for –N, –P, –K, –Ca, –Mg, –Mn, –Zn, and –B, with f1-scores of over 0.97. Deficiency is a relative concept, and a slight deficiency might be mistaken for full nutrition. In this study, another area for misclassification was among Fe, Mn, and Zn deficiencies which all shared some common symptoms of chlorosis. The nutrients are directly or indirectly related to chlorophyll formation or photosynthesis, the disruption of which generally causes chlorosis (Watchareeruetai et al., 2018). Furthermore, N deficiency was misclassified as S deficiency as both of them caused chlorosis in cotton leaves. These noticeable values can be extracted from the confusion matrix (Figure 4).

Application Analysis

ResNet50 demonstrate powerful capabilities in image recognition. Open source development frameworks lower the barriers to the application, as their versatile platform portability greatly facilitates the progression from concepts and plans to results and applications. New vision-problem applications can often use the architectures of networks already published in the literature alongside open source implementation to ease development, as prior studies might have solved various detailed technical problems such as the learning rate decay schedule or the hyper parameters. Optimizing hyper parameter settings is a significant challenge owing to the enormous time cost. Automatic model design represents a good solution as increasing numbers of applications are developed and shared (Pham et al., 2018). Although some DCNNs can rescale image size, it is necessary to pay attention to the spatial resolution conditions of the cotton leaf images. If the region of the identified object is too small in the overall image, the recognition accuracy will be affected. In addition, the background image can affect the recognition accuracy, especially in cases of multiclass identification. Unlike image recognition tasks involving the identification of people or car objects, the identification of nutrient deficiencies in cotton leaves involves discerning subtle differences of texture in often similar images. Recognizing nutritional deficiencies in cotton should consider surface texture as an identification feature, because this study aims to identify multiple images of nutrition deficiencies in cotton.

As compared with other datasets that are based on expert knowledge, the symptoms manifesting in the sand culture experiments would be more precise, because other factors such as pests and diseases are eliminated under controlled conditions and the data cover the entire cotton growing period. However, we did not consider combinations of more than one deficiency factor in this study, which reduced the robustness of the model. Sand culture experiments represent a time and resource intense means of data collection to build a model with generalized ability. Images alone are always insufficient for supervised classification, so any application should employ data augmentation techniques such as cropping, rotating, and flipping before running recognition processes (Perez and Wang., 2017). The application side should include a label function that uploads the confirmed prediction result to augment the dataset. As similar symptoms can lead to misclassification, offering the top-three predictions would be better than providing only one. Moreover, the symptoms associated with insect-pests and diseases are similar to the visual characteristics of nutrient deficiencies (Barbedo., 2016); thus, combined studies are needed to gain better insight into the identification of practical problems. This study in the short term will optimize the models and datasets for diagnosis of nutrient deficiencies in cotton. It can then be integrated into a mobile diagnosis system to facilitate cotton production by smallholder farmers. In the long run, if a model with greater generalization ability is proposed, the permissions of the mobile users to upload results with locations would provide a vast dataset to aid digital soil mapping and fertilization assessment from a macro perspective.

CONCLUSION

Different nutrient deficiencies alter the morphological characteristics of plant leaves in cotton. In this study, two DCNNs, viz., custom CNN and ResNet50 were used to diagnose various nutrient deficiencies in cotton plants based on image recognition using the dataset collected from sand culture experiment. ResNet50 obtained accuracies of over 90% and outperformed custom CNN. The best result was obtained using ResNet50 with the validation accuracy of 97.00% as compared VGGNet-16, which recorded the accuracy of 70%. These findings demonstrate that between the two DCNN models, ResNet50gives promising results for fully automatic classification of nutrient deficiencies in cotton.

Confusion Matrix

Confusion Matrix of Resnet50and VGG16 are given below

Classification Report of Rsenet50and VGG16

ResNet 50 VGG16

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Table 1. Parameters

Parameters	Custom CNN	**ResNet50**
No. of Convolution layers	5	48
Optimizer	Adam	Adam
Learning Rate	0.001	0.001
Drop out	0.3	-
Activation Function	ReLU	ReLU
Loss Function	Categorical CrossEntropy	Categorical Cross Entropy
Accuracy	70%(69.86)	97%

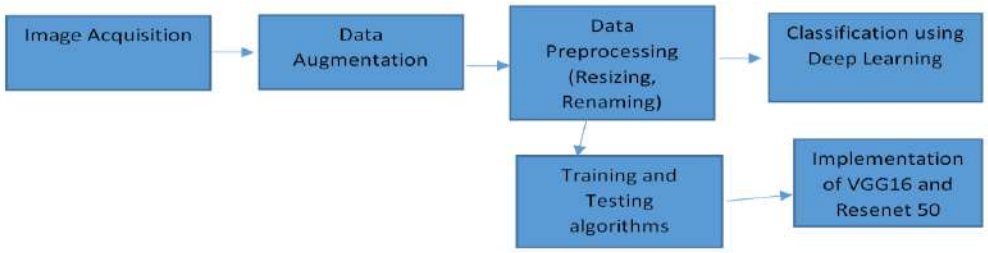

Figure 1: Proposed Architecture of plant deficiency classification

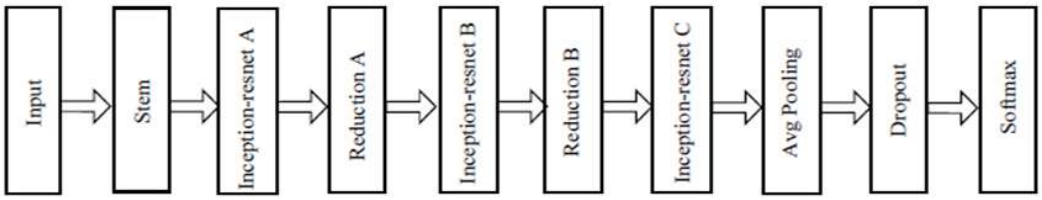

Figure 3 Architecture of Custom CNN

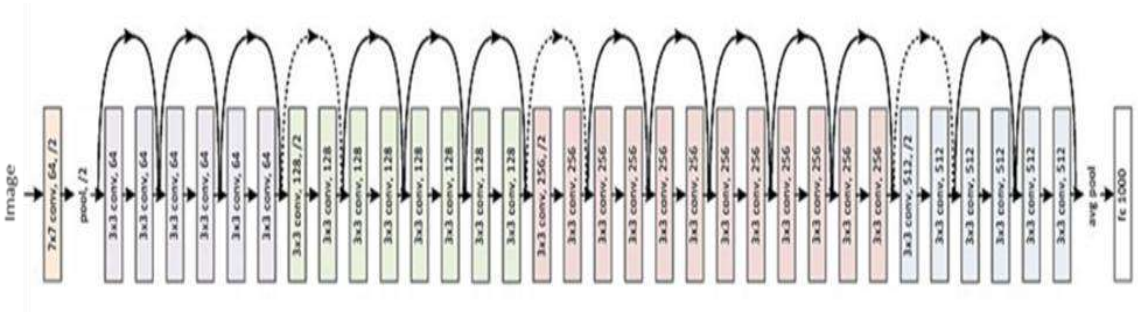

Figure 3: Proposed ResNet50

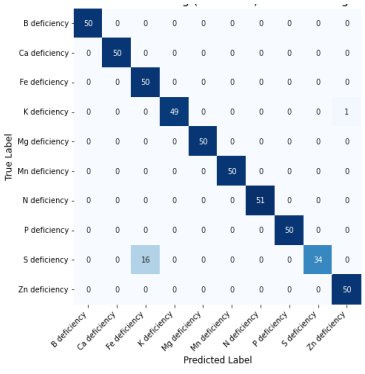

Figure 4 (a) Confusion matrix of Resnet50

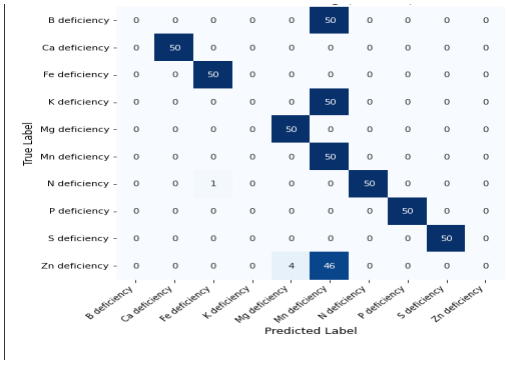

Figure 4. (b) Confusion matrix of VGG16

Resnet 50

```
[[50  0  0  0  0  0  0  0  0  0]
 [ 0 50  0  0  0  0  0  0  0  0]
 [ 0  0 50  0  0  0  0  0  0  0]
 [ 0  0  0 49  0  0  0  0  0  1]
 [ 0  0  0  0 50  0  0  0  0  0]
 [ 0  0  0  0  0 50  0  0  0  0]
 [ 0  0  0  0  0  0 51  0  0  0]
 [ 0  0  0  0  0  0  0 50  0  0]
 [ 0  0 16  0  0  0  0  0 34  0]
 [ 0  0  0  0  0  0  0  0  0 50]]
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        50
           1       1.00      1.00      1.00        50
           2       0.76      1.00      0.86        50
           3       1.00      0.98      0.99        50
           4       1.00      1.00      1.00        50
           5       1.00      1.00      1.00        50
           6       1.00      1.00      1.00        51
           7       1.00      1.00      1.00        50
           8       1.00      0.68      0.81        50
           9       0.98      1.00      0.99        50

    accuracy                           0.97       501
   macro avg       0.97      0.97      0.97       501
weighted avg       0.97      0.97      0.97       501
```

VGG16

```
[[ 0  0  0  0  0 50  0  0  0  0]
 [ 0 50  0  0  0  0  0  0  0  0]
 [ 0  0 50  0  0  0  0  0  0  0]
 [ 0  0  0  0  0 50  0  0  0  0]
 [ 0  0  0  0 50  0  0  0  0  0]
 [ 0  0  0  0  0 50  0  0  0  0]
 [ 0  0  1  0  0  0 50  0  0  0]
 [ 0  0  0  0  0  0  0 50  0  0]
 [ 0  0  0  0  0  0  0  0 50  0]
 [ 0  0  0  0  4 46  0  0  0  0]]
              precision    recall  f1-score   support

           0       0.00      0.00      0.00        50
           1       1.00      1.00      1.00        50
           2       0.98      1.00      0.99        50
           3       0.00      0.00      0.00        50
           4       0.93      1.00      0.96        50
           5       0.26      1.00      0.41        50
           6       1.00      0.98      0.99        51
           7       1.00      1.00      1.00        50
           8       1.00      1.00      1.00        50
           9       0.00      0.00      0.00        50

    accuracy                           0.70       501
```

Figure 5. Classification Report of Rsenet50and VGG16

Model Accuracy: 97%Model Accuracy: 69.86%

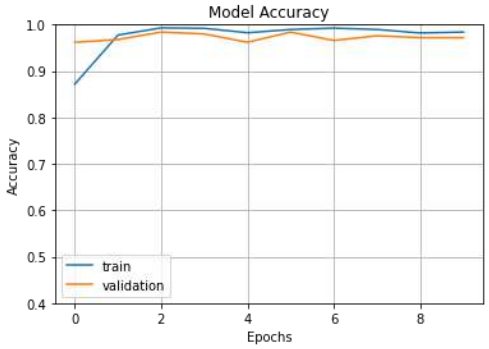

Figure 6 (a): Resnet50

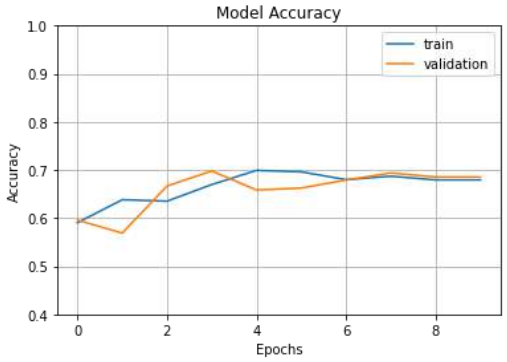

Figure 6 (b): VGG16

Figure 6. Accuracy Graph of Resnet50 and VGG16

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REVIEW ARTICLE

Diabetes Interventions: to Prevent Diabetes on a Global Scale a Systematic Review

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ABSTRACT

It is critical to understand the real-world consequences of lifestyle modification for diabetes prevention in order to make informed resource allocation decisions. The purpose of this study was to study various interventions to prevent diabetes. Studies published between 1995 and 2021 were searched in PubMed, Google Research, Research Gate, Embase, Cochrane Library, and the World Health Organization (WHO). Studies of any kind that tested lifestyle interventions, self-management, and pharmaceutical interventions were included in the effectiveness/translation studies. Diabetes will affect nearly half a billion people worldwide by 2021. Diabetes diagnoses have surged by 62%, from 285 million in 2009 to 463 million presently. Fifty percent of the people with diabetes are now ignorant of their illness. Self-management and telemedicine treatments will play a significant role in diabetes prevention. As a result, pharmaceutical therapy may be used in conjunction with a healthy lifestyle to help avoid diabetes. Metformin, sulphonylureas, thiazolidinediones, and insulin are examples of pharmacological interventions used to control diabetes. In 2021, diabetes is expected to impact 422 million people. Given that diabetes affects half a billion people worldwide, developing and implementing multi-sectoral solutions to combat the disease is critical. Without immediate and substantial action, diabetes will affect 578 million people in 2030, rising to 700 million by 2045. Diabetes will be controlled with the use of self-management, Telehealth, and pharmacological interventions.

Keywords: Diabetes; Intervention; Self-management; Telehealth; Pharmacological intervention.

INTRODUCTION

The gastrointestinal system's absorption of food and the liver's synthesis of glucose from dietary components are the two main resources of glucose in the human blood. Diabetes mellitus metabolic disorder defined by an abnormality in the glucose levels in the blood. Diabetes mellitus typically results in difficulties with insulin secretion and insulin mechanism of action. Except for type 1 diabetes, the diabetes categorization system is unique in that study findings demonstrate significant variation within each group. Patients can even migrate between categories [1]. Diabetes mellitus is classified into four major types: Insulin-dependent, Insulin independent, gestational diabetes, and combination with other complicated diseases. Two different types of diabetes mellitus are characterized by their management, aetiology andclinical course.

Diabetes is a chronic, serious condition that has a significant impact on the human life, most notably in developing nations [2]. According to estimates, around four million people died from this disease worldwide in 2017. Type 1 diabetes rates are also increasing, which is causative to the overall rise in diabetes occurrence. The reason for this increase is unknown. Better diabetes survival, as a result of early detection, improved diabetes management, and reduce premature mortality, is another factor contributing to the rise in prevalence. Finally, due to their longer survival, the rising number of younger persons with type 2 diabetes has contributed to the rise in overall type 2 diabetes prevalence in recent years. Periodic prevalence estimates and future forecasts for diabetes, as presented in successive editions of the International Diabetes Federation Diabetes Atlas, are essential for promoting type 2 diabetes prevention and stimulating changes in care for those who live with diabetes. A vacuum in epidemiological information is also identified by the Atlas, which must be filled in order to present a more complete picture of diabetes's consequences.

Included in this report are diabetes prevalence estimates for 2019, as well as undiagnosed diabetes and impaired glucose tolerance estimates for 2019, as well as diabetes and impaired glucose tolerance prevalence forecasts for 2030 and 2045 (541 million individuals have impaired glucose tolerance) [3]. All of the figures are based on the most recent and highest-quality epidemiological data available. Hyperglycaemia in pregnancy, including gestational diabetes mellitus, is covered in a separate study that includes estimates and projections for the condition. It is planned to publish a second paper on the complex and significant aspects of diabetes that affect the elderly population. One-third of persons with diabetes are admitted to the hospital at least twice a year, according to the American Diabetic Association (ADA). Treatment and management of diabetes are extremely expensive, with costs totalling $92 billion in the United States alone in 2012, and this amount is predicted to climb to $110 billion by 2021.

Increased blood glucose levels have been shown to harm to the body organs like heart, blood vessels, skin, kidneys, and nerves etc., creation diabetes a potentially fatal metabolic disorder. It is type 2 diabetes that affects the majority of people and happens when the body becomes immune to insulin or when the body does not produce enough insulin. Kind 2 diabetes is the most common type of diabetes and affects the majority of individuals. It is believed that type 2 diabetes is caused by the body growing immune to insulin or by the body not manufacturing sufficient insulin. Type 2 diabetes has become much more widespread in countries of all socioeconomic backgrounds over the prior three decades, and this has been true around the globe. Insulin-dependent diabetes, commonly known as type 1 diabetes, is a chronic disorder in which the pancreas generates very little or no insulin on its own, resulting in the accumulation of glucose in the bloodstream over time. In the United States, the most common kind of diabetes is known as Group 1 diabetes. For people with diabetes, the availability of low-cost diabetic drugs, such as insulin, is crucial to their long-term well-being. By the year 2025, a global agreement has been achieved to slow the rise of diabetes and obesity in the population. In the United States, diabetes is responsible for 1.6 million deaths every year. During the preceding several decades, both the number of cases and the incidence of diabetes have continuously increased, showing that diabetes is becoming a worldwide epidemic.

The Indian diabetes market is expected to reach a value of around USD 1,957 million by 2020, according to projections. It is estimated that the market would grow by 16.5 percent between 2021 and 2026, reaching a total value of around USD 4,892.7 million by 2026. India is one of seven nations that make up the South-East Asia area of the International Diabetes Federation, with the other countries being Indonesia, Malaysia, and Thailand. In the current globe, diabetes affects 463 million people, with 88 million of them people residing in Southeast Asia [4]. Diabetic complications and early death are, without a doubt, among the most preventable causes of illness and premature death in the developed world. Diabetes is thought to be responsible for one out of every 20 fatalities worldwide, and for one out of every 10 deaths among those aged 35 to 64 years old in the United States, according to the World Health Organization. It is anticipated that the incidence of diabetes will more than treble by 2030 if current trends continue in their current direction. In poor countries, a 150 percent increase is expected, with both men and women bearing the brunt of the load during their working years, according to the World Bank. Diabetes is a costly disease to treat because of the long-term consequences of the disease. In the future, diabetes is predicted to account for between 2.5 and 15 percent of global healthcare expenditures, depending on the incidence of the disease and the level of technological advancement available. Individual, family, and society's "indirect expenses" are more difficult to identify and calculate, but they are critical to understanding the overall financial picture.

DATA SEARCH

We looked for data sources on age-stratified diabetes prevalence published between 2020 and 2021 in PubMed, Medline, and Google Scholar, as well as other sources. The two-year search for a new president for 2020-2021 has been extended. The presence of diabetes or impaired glucose tolerance, as well as its prevalence, screening, or both, were sought. In addition, necessary citations from well-known studies were readily available. Several sources of information were explored, including data from national health surveys, personal communication, national databases, and Stepwise Approach to Surveillance studies.

INTERVENTIONS FOR DIABETES

Diabetes treatments can be targeted at individuals with diabetes, health-care practitioners, or the health-care system as a whole, depending on the situation (Figure 1). Patient-level treatments include medication administration, nutrition, physical activity, self-monitoring, and the most efficient use of available health-care resources, among other things.

Interventions for diabetes self-management

Patients and their families are in control of their diabetes to a large extent; self-management has evolved into an important component of diabetes treatment. One's behaviour and well-being can be improved by the practise of self-management, which is the active participation in self-care activities to achieve this goal. Meal planning, planned physical exercise, blood glucose monitoring, taking diabetic medications, and managing periods of sickness, low blood glucose, and high blood glucose are all examples of self-management strategies. Medical and nursing specialists as well as dietitians and pharmacists collaborate on the development of self-management treatment programmes for chronic conditions such as diabetes and hypertension. Self-management measures that assist in maintaining tight glycaemic control can help to reduce the severity of diabetes-related complications [5].

Cognitive therapy

Behavioural therapy is a patient-centred approach to behaviour change that helps patients understand and overcome their resistance to change (Figure 2). Miller and Rollnick developed motivational interviewing to assess a patient's hesitation toward lifestyle changes [6]. The principles of motivational interviewing are: This attitude to change must be resolved by the patient, not the practitioner, and the doctor's role is to recognise this ambivalence and be directive in assisting the patient in exploring and resolving this indifference [7].

Interventions based on technology

Recent years have seen an explosion in the use of tools and software designed to assist diabetes patients with their self-management. Because of the ubiquitous usage of computers, the Internet, and mobile devices by consumers,

there is a potential for these platforms to be used to enhance traditional medical care. Diabetes education and self-care support can be delivered to a larger number of patients through the use of technological means [8, 9]. While many healthcare organisations and researchers think that technology-driven solutions will enhance patient outcomes while also saving money, the effectiveness of these solutions has been inconsistent over the past decade. Among the many modalities that are commonly referred to as Telehealth include telephone, video teleconferencing, computer, and internet/web-based technology, to name a few. Various technical modalities are employed in technology-based interventions to track outcomes, provide self-management instruction, and provide self-management methodologies [10].

Programs for modifying one's lifestyle

A lifestyle modification programme is a wide phrase that refers to any intervention that tries to enhance health by altering a person's way of life and behavioural patterns. Programs for lifestyle modification can cover a wide range of topics, such as diet, physical activity, medications, and stress; they can take place in a variety of settings such as healthcare organisations, workplaces, or the community; and they can be delivered through a variety of mediums, such as face-to-face interactions, telephonic conversations, and online resources. Lifestyle modification programmes have a long history in the field of diabetes care, and they often comprise interventions that target food, physical activity, medication management, and behaviour modification among other things. Making the lifestyle change programme unique to each individual has been highlighted as a crucial success element [11, 12].

Education

According to a Malaysian study, one of the challenges to excellent glycaemic management is a lack of understanding and knowledge of diabetes. Patient education on diabetes treatment can enhance glycaemic, blood pressure, and cholesterol control, physical activity, food management, and drug understanding and adherence [13].

Diabetes Prevention Using Pharmacologic Interventions

To prevent diabetes, pharmacological medication may be used in conjunction with lifestyle adjustments to help reduce the risk of developing the disease. In addition, to address sedentary behaviour and obesity, population-based interventions are required to be implemented. [14, 15] [14, 15] [14, 15] Metformin [16,17], sulphonylureas [18,19], thiazolidinediones [18], and insulin [19] are examples of medications that have been studied. In addition to newer medications such as incretin therapies and sodium-glucose co-transporter inhibitors, two inhibitors of the glucose transporter have been studied in randomised controlled trials to prevent diabetes, with different degrees of success. Diabetes can be prevented by the use of non-glucose-lowering drugs such as orlistat and renin-angiotensin system blockers, however statins are associated with a slight increase in risk. Patients' individual circumstances and phenotypic profile should be taken into consideration when determining whether or not these medications should be used in the prevention of diabetes. But translating successful clinical trials into real-world applications is particularly difficult because lifestyle alterations require continual support from healthcare professionals in order to be sustained. [20].

Difficulties

Diabetes eradication is unlikely due to the fact that it is a chronic disease with no single underlying factor. Due to the fact that it has the greatest impact on the population at risk - the South-East Asian cohort, with India in the forefront - the genetic basis for this disease is particularly noteworthy. A country's primary health organization's response to illness challenges is the humblest thing it can do, and its leaders must make plans to combat and track the progression of the disease throughout the country. The consequences of diabetes grow much more severe if other chronic disorders affecting the cardiovascular and urinary systems are not treated, enabling the disease to progress with dignity. In a country like India, the dearth of solid epidemiological data adds to the difficulties. Another issue is the national health system's incapacity to collaborate with other global health organizations, which has major consequences for achieving policy-based objectives [21].

The Financial Problem of Prevalence

The prevalence of diabetes in India has outstripped the country's ability to treat it, resulting in a large number of cases being unnoticed. Diabetes has a long history in India, dating back to 2500 BC, when the disease was referred to as 'Madhumeha' in ancient Indian scriptures. Diabetes is a chronic disease that affects the pancreas and causes insulin resistance. This shows that the ailment has been recognised for a long time, and that the prevalence may not have been as high as it is now at the time of publication. In India, diabetes has a significant economic impact, with the costs of obesity accounting for 1.1 percent of the country's gross domestic product (GDP). When it comes to diabetes, the prevalence of the disease is related to the economic burden it places on a community, as diabetes affects both high- and low-income countries [22].

Diabetes projections are computed

The United Nations Development Programme middle 2030 and 2045 population projection statistics were utilized, and the rates of urbanization were adjusted for future diabetes prevalence forecasts in 2030 and 2045. Other than age and the amount of urbanization, the diabetes prevalence forecasts for 2030 and 2045 did not explicitly include expected changes in any diabetes risk variables. For the years 2030 and 2045, global-age standardized diabetes prevalence was calculated by comparing each country's prevalence to the standard world population in 2030 and 2045, respectively. The estimated UN population projections for 2030 and 2045 were used to construct global age structures for 2030 and 2045, respectively [23].

Diabetes estimates for 2021, with forecasts through 2045

In 2021, diabetes will affect 573 million people worldwide, or 9.3 percent of the adult population. This figure will increase to 578 million in 2030 and 700 million in 2045. In 2019, diabetes is expected to affect 9.0% of females and 9.6% of males. Diabetes prevalence increases with age, reaching 19.9% among adults aged 65 to 79 years. Diabetes prevalence varied according to World Bank income group, with higher prevalence in high- and middle-income countries than in low-income countries. By 2045, the prevalence of diabetes is expected to reach 11.9 percent in high-income countries, 11.8 percent in middle-income countries, and 4.7 percent in low-income countries [24]. The vast majority of diabetics live in cities, accounting for 67.0 percent of all diabetics. In Pakistan, for example, a recent study discovered that urban areas have a marginally higher prevalence of diabetes than rural areas [25, 26].

DISCUSSION

Diabetes is a major health concern that has spread to epidemic proportions in recent decades. Diabetes will affect about half of the world's population, or 537 million people, by 2021. Since 2009, the number of people with diabetes has increased by 62 percent, from 285 million in 2009 to 537 million now. About half of those who have diabetes are completely unaware of their illness at the moment. Several factors are contributing to the rise in Type 1 diabetes in children, particularly in younger children, according to the International Diabetes Federation Diabetes Atlas findings, which cannot be quantified. These factors include sedentary lifestyles, high-energy dietary intakes, and other as-yet-unknown factors; and intergenerational transmission of Type 1 diabetes in children, particularly in younger children. The earlier detection of Type 2 diabetes, as well as improved care for all forms of diabetes, have both contributed to the rise in prevalence of diabetes.

Considerations and suggestions for the future

It is our goal to develop suggestions for the conduct of high-quality diabetes epidemiological research, as well as for the presentation of their findings, in a manner that will be acceptable for inclusion in future Atlas editions and other diabetes compendiums. It is necessary that these standards be reasonable in terms of available resources, and they may be graded in a variety of ways, including the lowest acceptable level, a more ambitious level, and the "gold standard." Additionally, a list of potential threats should be reviewed. In addition to diagnostic procedures, sample size, representation, data source age and publishing type. It is necessary to agree on appropriate levels of participation. To ensure that future Atlas editions can incorporate data from ordinary administrative sources more

frequently, protocols for acquiring, validating, and presenting data from routine administrative sources must be agreed upon. National diabetes statistics should be gathered in all countries, and existing databases should be expanded where necessary. Countries that already have national diabetes databases should continue to collect high-quality, up-to-date information on the disease. It is imperative that prompt action be taken in countries that do not have national databases to mobilise resources for epidemiological surveillance and research that adheres to high scientific standards. Using this method, it is possible to portray the true burden of diabetes and set targets for national and international health programmes.

CONCLUSION

In the year 2021 537 million people are suffering with Diabetes.Four in five adults having the diabetes and 6.7 million deaths in the year of 2021. With half a billion people worldwide suffering from diabetes, it is critical to develop and execute multi-sectoral solutions to combat the disease. Without urgent and serious action, 578 million people are expected to get diabetes in 2030, increasing to 700 million by 2045. Self-management, Telehealth and pharmacological intervention will be a help to control diabetes.

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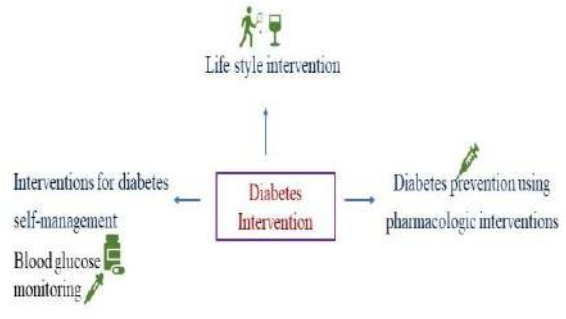

Figure 1: Diabetes intervention

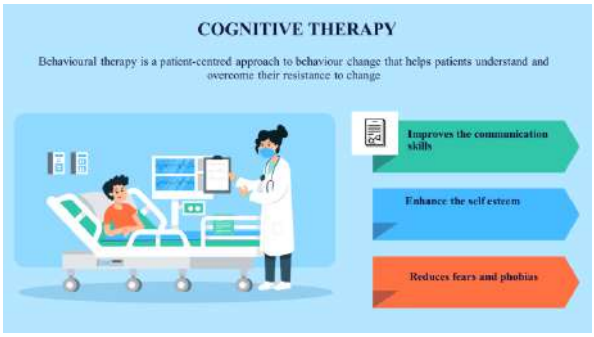

Figure 2: Cognitive therapy

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RESEARCH ARTICLE

Impact of Foliar Application of Nutrients on Economics of Rice Fallow Blackgram

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ABSTRACT

Important pulse crop grown during the month of January to march in Cauvery Delta Zone, Tamil Nadu under rice fallow condition is Blackgram. It grows in the residual soil moisture, which is sown at 7-10 days before the harvest of paddy crop. The United Nations declared 2016 as "International Year of Pulse" (IYP) to heighten public awareness of the nutritional benefits of pulses as part of sustainable food production aimed at food security and nutrition. In order to identify a suitable foliar nutrition for Rice fallow Blackgram an field experiment was conducted during rice fallow season 2019 at the Experimental farm, Department of Agronomy, Annamalai University, Annamalainagar, to study the strategies for yield maximization in rice fallow blackgram (ADT-3)under rice fallow condition. The experiment revealed that effect of foliar application of nutrition panchagavya, DAP, $MnSO_4$ on the Economics of rice fallow blackgram. The Economic parameters of Blackgram *viz*., Gross income, Net income, BCR were favorably influenced by the foliar application of 3% Panchagavya + 2% DAP + 1% $MnSO_4$ (T_8) at 25 and 45 DAS.

Keywords: Foliar nutrients- rice fallow Blackgram (ADT-3), panchagavya, DAP, $MnSO_4$

INTRODUCTION

The United Nations declared 2016 as "International Year of Pulse" (IYP) to heighten public awareness of the nutritional benefits of pulses as part of sustainable food production aimed at food security and nutrition (Mohanty *et al*., 2015). Blackgram is an important pulse crop grown during the month of January to march in Cauvery Delta Zone, Tamil Nadu under rice fallow condition. It grows in the residual soil moisture, which is observed at 7-10 days before the harvest of paddy crop. Since the blackgram grown under paddy stubbles, It has to survive from residual

nutrients and moisture present in the soil, besides frost and mist available during the period and complete the lifecycle within 56-70 days of sowing. Among all fertilizer application methods, foliar fertilization is more suitable under moisture stress condition and also farmers can easily adopt this method efficiently. The foliar application of micronutrients may be 6 to 20 times more efficient than soil application (Arif *et al*. 2006). Foliar spray of different micronutrients has been reported to be equally or more effective as soil application by different researchers (SeifiNadergholi*et al*., 2011). Area under rice fallow condition in the cauvery delta zone accounts for 30.5 per cent andthere is a possible expansion of area under blackgram to an extent of nearly two lakh hectares especially under rice fallow condition.

MATERIALS AND METHODS

The field experiment was carried out at field number GL12B of Experimental farm, Department of Agronomy, Annamalai University, Annamalai Nagar. The experimental farm is geographically situated at 11° 24' North Latitude and 79° 44' East Longitude at an altitude of + 5.79 m above mean sea level. The experiment consisted of eight treatments. The experiment was laid in Randomized Block Design with three replications*viz*., Control (T_1), Foliar application of Panchagavya @ 3% (T_2), Foliar application of DAP @ 2% (T_3), Foliar application of $Mnso_4$ @ 1% (T_4), Foliar application of Panchagavya @ 3% + DAP @ 2% (T_5), Foliar application of Panchagavya @ 3% + $MnSO_4$ @ 1% (T_6), Foliar application of DAP @ 2% + $MnSO_4$ @ 1% (T_7), Foliar application of Panchagavya @ 3% + DAP @ 2% + $MnSO_4$ @ 1% (T_8) at 25 and 45 DAS.

RESULT AND DISSCUSION

The economics of various treatments are furnished in Table 1. The economics parameters such as gross return, net return, and return rupee^{-1} invested were calculated based on prevailing market price. Among the different treatments, foliar application of 3% Panchagavya + 2% DAP + 1% $MnSO_4$at 25 and 45 DAS (T_8) recorded higher gross income (Rs. 42486) net income (Rs.30736) and return rupee^{-1} (3.61). The least gross income (Rs.28800) and return rupee^{-1} (2.68) was observed under control (T_1). This might be due to higher grain yield and haulm yield recorded with this treatment. Despite the additional input cost involved, the substantial yield increment obtained with this treatment might have resulted in increased net income and return rupee^{-1}. The least return rupee^{-1} invested was observed under control. This might be due to reduced grain yield resulting in least gross income and net return. The present results are in agreement with earlier findings of Pradeep Mohan Dixit and Elamathi (2007), Shashikumar *et al.* (2013), Marimuthu and Surendran (2015), Ramesh *et al.* (2016) and Pradeepa and Ganajaximath (2017).

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Table 1. Impact of foliar application of nutrients on economics of rice fallow blackgram

Treatments	Gross income (Rs.ha^{-1})	Net income (Rs.ha^{-1})	Return rupee^{-1} Invested	Seed yield (kg ha^{-1})
T_1-Control	28800	18087	2.68	454
T_2- Foliar application of Panchagavya @ 3% at 25th and 45th DAS	35980	24245	3.06	570
T_3 - Foliar application of DAP @ 2% at 25th and 45th DAS	34743	23023	2.9	550
T_4- Foliar application of $MnSO_4$ @1% at 25th and 45th DAS	31051	19786	2.7	490
T_5- Foliar application of Panchagavya @ 3%+DAP@2% at 25th and 45th DAS	40831	26961	2.94	648
T_6- Foliar application of Panchagavya @ 3% +$MnSO_4$ at 1% at 25th and 45th DAS	39710	25938	2.8	630
T_7- Foliar application of DAP at 2%+$MnSO_4$ @1%at 25th and 45th DAS	37219	24763	2.98	590
T_8- Foliar application of Panchagavya @ 3%+DAP @2%+$MnSO_4$ @1% at 25th and 45th DAS	42486	30736	3.61	675
S.Ed				**12.14**
CD (p=0.05)				**26.00**

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RESEARCH ARTICLE

Non-Surgical Treatment of Chronic Periodontitis by Local Drug Delivery of Lycopene Chips in Periodontal Pockets: A Pilot Study

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ABSTRACT

Lycopene (LYC) is an acyclic isomer of beta-carotene. Animals cannot synthesise it; only plants or autotrophic microorganisms can. Tomatoes, watermelons, pink grapefruits, apricots, pink guavas, papaya, and other red fruits and vegetables contain Lycopene. The antioxidant abilities of this carotenoid are quite potent. Periodontal tissue damage due to oxidative stress can happen directly or indirectly.When compared to other carotenoids, the major carotenoid found in tomato products, lycopene, has the best potential to quench singlet oxygen. It is also excellent at shielding blood cells from NOO-radical damage.Hence, the aim of the present study isto reduce inflammation of gingiva and the depth of periodontal pocket by non-surgical treatment of Chronic Periodontitis by placing Lycopene chips in to the periodontal pockets. Methodology: The study design consisted of total 20 sites, in 20 patients with 10 patients in test group with one site in each patient and 10 patients in control group with one site in each patient of Chronic Periodontitis patients attending the Department of Periodontology for treatment. Results: The reduction in probing pocket depth from baseline to Post op-15 Days for Group A

was 0.80 ± 0.42 and Group B was 1.70 ± 0.48. It was compared using Mann Whitney u test. It was found to be significantly higher in group B.

Keywords: lycopene, antioxidants, anticarcinogenic agents, radioprotection, Chronic Periodontitis.

INTRODUCTION

Lycopene as a fat-soluble carotenoid was identified by Ernest et al. in 1959[1]. It is a distinctive component of some algae and parasites, as well as red foods that are cultivated from the earth. The main dietary sources of lycopene for humans are tomatoes and items made with tomatoes. The carotenoids are one of the most prevalent and significant classes of pigments in nature, particularly because of their variety of roles[2]. Ahydrocarbon with 11 conjugated and 2 unconjugated double bonds, lycopene is highly unsaturated. It undergoes cis-trans isomerization as a polyene, which is triggered by light, heat energy, and synthetic reactions. With a singlet-oxygen-extinguishing capacity that is several times higher than that of alpha-tocopherol and two times that of beta-carotene, lycopene is arguably the most potent antioxidant. Utilizing Lycopene is associated with a decreased likelihood that degenerative illnesses caused by free radicals, such as cancer, cardiovascular diseases, asthma, joint discomfort, stroke, cataractogenesis, hepatitis, and periodontitis, will improve [3]. Lycopene is the most effective biological antioxidizing agent because of its unusual property of binding to chemical entities that react to oxygen [4]. The aim of this pilot study is to check whether the periodontal pockets can be treated non-surgically with the help of lycopene chips. The local drug delivery into the periodontal pocket has been shown to promote periodontal health. It can prevent bacterial pathogenesis and suppress inflammation even more[5]. Since very less literature is present on the local drug delivery of Lycopene, the present study is taken with the aim to check the reduction in inflammation of gingiva and improvement in the depth of periodontal pocket by non-surgical treatment of Chronic Periodontitis by placing Lycopene chips in the periodontal pockets.

MATERIALS AND METHODS

AIM: The aim of our study isto reduce inflammation of gingiva and the depth of periodontal pocket by non-surgical treatment of Chronic Periodontitis by placing Lycopene chips in to the periodontal pockets.

Study Design:
A randomized clinical trial was conducted at the Department of Periodontology, SGT dental college and research institute, Gurugram, Haryana. Ethical approval was obtained from the ethical committee. The aims, design, and methods of the current study were explained to the potential candidates who were invited to participate and when agreement was obtained, they were asked to sign a consent form before commencing any treatment. Participants were recruited from patients referred for periodontal treatment and eligible individuals were selected according to the inclusion/exclusion criteria.
The Exclusion criteria were as follows:

- Subjects having periodontal or any dental abscess.
- Subjects having severe periodontitis.
- Subjects having periodontal pocket depth more than 5mm.
- Subjects taking any kind of antibiotics.
- Subjects not willing to take part.
- Lactating women.
- Subjects who had undergone periodontal surgery recently.
- Pregnant women

The Inclusion criteria were as follows:

- Subjects having periodontal pocket depth equal to or less than 5mm.
- Subjects who get ready to sign the consent.
- Well-motivated patients.
- Subjects who are not taking any kind of antibiotics or who have not taken any kind of antibiotics in the last 6 months.
- Subjects who are not taking any kind of antioxidants at the time of the start of the study or in the last 6 months.
- The study design consisted of total 20 sites, in 20 patients with 10 patients in test group with one site in each patient and 10 patients in control group with one site in each patient of Chronic Periodontitis patients attending the Department of Periodontology for treatment.

Test Group A (n=10): Lycopene chips were placed followed by SRP at 1 site in each patient.
Test Group B (n=10): Control group with SRP alone at 1 site in each patient.
Two clinical parameters were used to investigate the primary outcomes, including Sulcular Bleeding Index (SBI) and Probing Pocket Depth (PPD). On the first visit, pre-treatment, initial clinical parameters were recorded. First, SBI followed by PPD. All clinical parameters were recorded using UNC 15 periodontal probe. This was followed by providing the patient with oral hygiene instructions, which included advice regarding toothbrushing and the use of interdental aids, while the use of mouthwash was prohibited during the study period. The treatment started with supragingival scaling using an ultrasonic scaler followed by SRP and clinical parameters at baseline were assessed. For non-compliant patients, instructions were given. Patients were recalled after 15 days for re-evaluation. Evaluation included re-assessment of the clinical parameters- SBI and PPD in both the groups.

RESULTS

The study incorporated of 20 patients with 1 site per patient with two groups: 10 in test group and 10 in control groups of Chronic Periodontitis patients. Reduction in PPD was observed in group A (test group) after 15 days. The difference between the two groups was statistically significant. The distribution of patients was 50% each in both the groups At Pre-op, the Sulcular Bleeding Index for Group A was 2.7 ± 0.483 and Group B was 2.7 ± 0.483. The comparison was done using Mann Whitney U test. The difference was not found to be significant. At post-op, (after 15 days of treatment) the Sulcular Bleeding Index for Group A was 1.6 ± 0.51 and Group B was 0.60 ± 0.699. The comparison was done using Mann Whitney U test. It was found to be significantly lower in group B. The Sulcular Bleeding Index at Post op-15 days was compared using Mann Whitney U test. It was found to be significantly lower in group B. The reduction in Sulcular Bleeding Index from baseline to POST OP-15 DAYS for Group A was 1.10 ± 0.31 and Group B was 2.10 ± 0.56. It was compared using Mann Whitney u test. It was found to be significantly higher in group B. At Pre-op, the probing pocket depth for Group A was 5.0 ± 0 and Group B was 5 ± 0. The comparison was done using Mann Whitney U test. The difference was not found to be significant. At post-op 15 days the probing pocket depth for Group A was 4.2 ± 0.42 and Group B was 3.3 ± 0.483. The comparison was done using Mann Whitney U test. The probing pocket depth AT Post op-15 days was compared using Mann Whitney U test. It was found to be significantly lower in group B. The reduction in probing pocket depth from baseline to Post op-15 Days for Group A was 0.80 ± 0.42 and Group B was 1.70 ± 0.48. It was compared using Mann Whitney u test. It was found to be significantly higher in group B.

DISCUSSION

Various researchers have suggested antioxidant therapy as a possible strategy to combat periodontal disease[6]. Lycopene, the most abundant carotenoid in tomatoes, is an effective natural antioxidant[7]. It is also reported to positively affect the immune system by anti-apoptotic effect, and enhancement of phagocytic and bacterial killing activity of neutrophilic cells[8]. However, it is pertinent to state that these carotenoids and other plant compounds have developed sets of interacting elements and this complexity of arrangement limits their individual identity[9].

The aim of the present study was to evaluate the efficacy of local drug delivery of lycopene chips as an adjunct to SRP in terms of changes in the levels of PPD and CAL. A short-term evaluation period of 15 days was selected for the present study as adopted in other interventional studies assessing the efficacy of various adjunctive treatment modalities to initial nonsurgical periodontal therapy[10]. Evaluation of the results of the present study after 15 days of intervention appears rational, although a longer follow-up could have resulted in more definitive results[11].In a study "Effect of Lycopene in the Treatment of Periodontal Disease: A Clinical Study" done by Belludi SA et al [12] in the year 2013, they concluded that lycopene is a promising treatment modality as an adjunct to full mouth SRP of the oral cavity in patients with moderate periodontal disease. Similar results were also reported by Chandra et al [13] who concluded that there was a positive correlation between salivary uric acid levels and gingival parameters in gingivitis patients treated with lycopene as an adjunct to mechanical therapy. In this study, it was observed that although the mean reduction in GI (Gingival Index) was higher in the lycopene and SRP group than in the Lycopene group, there were no statistically significant differences between these two groups. In a study "The adjunctive use of systemic antioxidant therapy (Lycopene) in nonsurgical treatment of chronic periodontitis: A short-term evaluation" done by Arora et al [14], indicate that SRP augmented with concomitant use of antioxidant supplementation resulted in improved periodontal parameters PI, MGI, and BOP, but not the other parameters like mean PPD reduction and CAL gain. Salivary uric acid levels, which were initially low in subjects with chronic periodontitis, increased to statistically significant levels and this coupled with decreased levels of salivary IL-1` encourages a rational use of such supplementation in the management of periodontal disease.

Further longitudinal studies are required to establish the role of lycopene supplementation in the management of chronic periodontitis. In a study "Evaluation of the efficacy of lycopene gel compared with minocycline hydrochloride microspheres as an adjunct to nonsurgical periodontal treatment: A randomised clinical trial" done by Ali A et al[15] in the year 2020 concluded that twenty-three patients with periodontitis completed the study. Both ARISTIN and Lycopene treatments showed significantly greater gains in attachment (1.94 and 1.33 and 1.72 and 0.88, respectively) than the Control treatment (1.04 and 0.96). Compared with those in the Control, only ARISTIN showed a significant reduction in IL-8 level, whereas TIMP1 levels were significantly upregulated in the Lycopene gel and ARISTIN sites. The effect size estimation indicated that Lycopene gel exhibited considerably greater efficacy than the Control gel. In a study "Efficacy of Lycopene in the Treatment of Gingivitis: A Randomised, Placebo-controlled Clinical Trial" done by Chandra RV et al [16] in the year 2007 concluded that all the treatment groups demonstrated statistically significant reductions in the GI, SBI and PI. Treatment with Oral Prophylaxis (OP)- Lycopene resulted in a statistically significant decrease in GI when compared with OP-placebo ($p < 0.05$) and non-OP-placebo ($p < 0.01$). Treatment with non-OP-lycopene resulted in a statistically significant decrease in GI when compared with non-OP-placebo ($p < 0.01$). The OP-Lycopene group showed a statistically significant reduction in SBI values when compared with the non-OP-Lycopene group ($p < 0.05$) and the non-OP-placebo group ($p < 0.001$). There was a strong negative correlation between the salivary uric acid levels and the percentage reduction in GI at 1 and 2 weeks in the OP-Lycopene group ($r = -0.852$ and -0.802 respectively) and in the non-OP-Lycopene group ($r = -0.640$ and -0.580 respectively). The results presented in this study suggest that Lycopene shows great promise as a treatment modality in gingivitis. The possibility of obtaining an additive effect by combining routine oral prophylaxis with Lycopene is also an exciting possibility, which deserves further study.

CONCLUSION

Lycopene as an adjunctive treatment was compelling in lessening periodontal probing depth and gain in CAL. Further longitudinal investigations with a bigger example size are required to establish the role of lycopene in the management of chronic periodontitis.

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Table 1:Distribution of patients among two groups.

		N	%
GROUP A	Lycopene chips were placed followed by SRP	10	50
GROUP B	Control group	10	50

Table 2: Comparison of Sulcular Bleeding Index among two groups

		N	Mean	Std. Deviation	mean difference	p value
Pre-op: At baseline	GROUP A	10	2.700	.4830	0.0000	1.000,Ns
	GROUP B	10	2.700	.4830		
Post-op: after 15 days of treatment	GROUP A	10	1.600	.5164	1.0000	0.007*, sig
	GROUP B	10	.600	.6992		
REDUCTION: (BASELINE-15 DAYS)	GROUP A	10	1.10	.316	-1.000	0.003*, sig
	GROUP B	10	2.10	.568		

Mann Whitney u test, level of significance set at $p < 0.05$

ns: non-significant *sig: statistically significant

Table 3: Comparison of Pocket Probing Depth among two groups

		N	Mean	Std. Deviation	mean difference	p value
Pre-op: baseline	GROUP A	10	5.000	.0000[a]	0.0000	1.000,Ns
	GROUP B	10	5.000	.0000[a]		
Post-op: 15 days	GROUP A	10	4.200	.4216	.9000	0.0001*, sig
	GROUP B	10	3.300	.4830		
REDUCTION: (BASELINE-15 DAYS)	GROUP A	10	.80	.422	-.900	0.003*, sig
	GROUP B	10	1.70	.483		

Mann Whitney u test, level of significance set at $p < 0.05$ ns: non-significant *sig: statistically significant

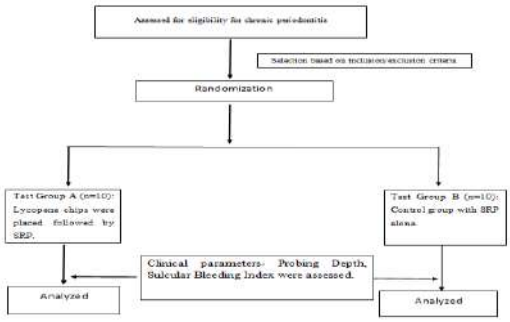

Figure 1: Flow chart of the study design

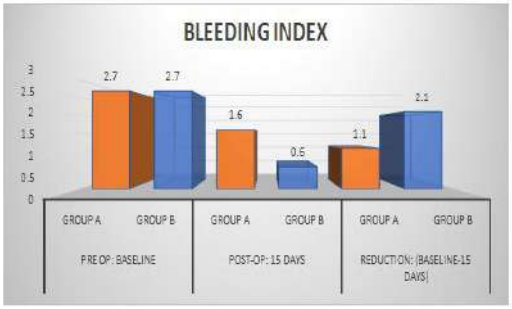

Figure 2: Bleeding Index at Pre-op: Baseline, Post-Op:15 days, Reduction: Baseline-15 days.

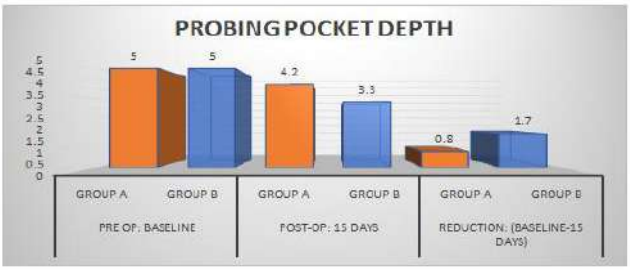

Figure 3: Pocket Probing Depth at Pre-op: Baseline, Post-Op:15 days, Reduction: Baseline-15 days.

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REVIEW ARTICLE

Supplementation of Area Specific Mineral Mixture to Improve Production and Reproduction in Dairy Cows: An Overview

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ABSTRACT

Soil is a source of minerals to plants. These plant based feed and fodder are the source of minerals to cattle. Mineral content of feed and fodder crops vary in different areas of Tamil nadu as well as in different states. Feed and fodder fails to provide all the essential minerals required for the health, production and reproduction of dairy cows. Hence supplementation of area specific mineral mixture is very vital to improve dairy cattle physiology and performance. TANUVAS/NIANP/NDDB formulated area specific mineral mixture supplemented @ 50-100g/day/cow has significantly improved milk production, fat, SNF content and its reproductive performance. Area specific mineral mixture is also economical as it provides only essential minerals required for cows in the particular area.

Keywords: Minerals, Area Specific, Production, Reproduction, Milk yield

INTRODUCTION

India ranks first in milk production among other milk producing countries. In spite of its *numero uno* position, milk yield per cow was less compared to other countries. Under Indian conditions, the average milk yield of exotic cow is 11.8 kg/day, cross bred is 8.09 kg/ day, indigenous breed is 3.9 kg/ day and nondescript cow is 2.57 kg/ day [1]. Inefficient reproduction is also a serious issue among Indian cattle. Nutrients are integral to dairy cattle performance [2] and play a very crucial role in regulating biological systems [3]. Among nutrients, minerals play a vital role in cattle physiology that includes metabolic functions, maintenance of health, growth, milk production and reproduction [4]. Major minerals such as calcium, phosphorus, potassium, magnesium and minor minerals like zinc, copper, iron, manganese and iodine are important. Ultra trace minerals such as cobalt and selenium are also essential

[5]. Soil is a source of minerals to plants. These plant based feed and fodder are the source of minerals to animals. Interrelationship exists between soil, plant and animals in transfer of minerals [6]. In India, crop residues that constitute a major portion of the diet of dairy animals are also poor in essential minerals [7]. Feed and fodder has low mineral content if the soil in which it was grown is deficient in minerals. Deficiency of minerals was one of the major causes for poor milk production and reproduction. Dairy cows cannot synthesize minerals on their own and have to depend on the external source. Feed and fodder do not provide all the essential minerals in required quantity to the dairy cows. In order to fulfil its daily need, supplementation of adequate quantities of good quality mineral mixture is vital to overcome the deficiency, production and health losses [8, 9]. As the level of minerals in feed and fodder varies from area to area and its bioavailability to animal, it is essential to provide area specific mineral mixture (ASMM) [10]

Area Specific Mineral Mixture

At present, commercial mineral mixtures are prepared and marketed without considering the actual deficiency or excess of minerals in animals of the region. An excess of minerals is taxing to the animal system because of the stress on organs and the extra energy animals spend in their excretion [11].On the other hand, supplementation of required minerals in deficient diets enhanced the performance in animals [12]. Area Specific Mineral Mixture refers to specific minerals that are deficient in a particular area and they are supplemented in the form of mineral mixture. TANUVAS studied the mineral profile of soil, plant and animals in each of the agro climatic zones of Tamilnadu and formulated ASMM for each district. TANUVAS – SMART mineral mixture contains only five to seven minerals that are specifically needed to the particular area instead of twelve minerals as per BIS standards. Supplementation of ASMM is more practical and cost-effective as it contains only specific minerals that are required in that area and it avoids antagonistic effects due to excess levels of other minerals. ASMM is cheaper than BIS specification based conventional mineral mixture [13] .

Impact of area specific mineral mixture on milk production and reproduction in dairy cows

Dairy cows fed with TANUVAS mineral mixture showed improvement in milk yield by 1.0 litre per day [14] and 1.45 litres per day [15], milk fat by 1.73% [14] and 1.21% [15]. The SNF content has improved by 0.77% [14] and 0.67% [15] compared to animals that are not fed with mineral mixture. Overall status of the animals was good and healthy [15]. Dietary supplementation of ASMM in crossbred cattle improved the productive as well as reproductive performances [16]. Long term benefits in supplementation of ASMM in milch cows include early onset of first postpartum estrum, increase in conception rate and milk production[15]. A significant ($P<0.05$) improvement in milk yield by 1.36 litre per day (18.68 %) and reproductive function was reported [3]. Addition of ASMM in the feed of heifers has stimulated its reproductive characteristics [17]. Supplementation of NIANP formulated ASMM has increased the milk yield by 0.5-1 litres per day and milk fat by 0.4-0.5 units per day [18]. Milk yield and fat corrected milk (FCM) yield increased by 9.5 and 11.8%, respectively due to inclusion of ASMM in the rations of lactating cows in Uttarakhand [11]. After supplementation of TANUVAS formulated ASMM, 84.2% of postpartum anoestrus cows exhibited estrum and 85.71% conceived within 60 days [12]. Among repeat breeders 78.6% of cows conceived and onset of estrus was successful in 66.7% of delayed pubertal cows. In case of silent heat cows, 66.7% conceived within 90 days after ASMM supplementation [12]. Estrus cycle was resumed in 80-90% of animals and 50-60% of cows became pregnant within 70 days after ASMM supplementation [18]. NDDB formulated ASMM improved the growth rate in calves, favours early puberty, improves reproduction efficiency in both male and female animals, reduce inter-calving period, increases productive life of animals, improves feed efficiency, improves milk production, increases SNF content and provides better immune response and resistance against diseases. NDDB suggested ASMM @ 100-200 g daily, for lactating animals, 50 g daily for growing and non-producing animals and 25 g daily for calves [19].

In buffaloes, ASMM has not only increased the milk yield but also reduced the post-partum estrus period, total number of AI or Natural service per conception, service period, cost of per litre of milk production and consequently improved the socio-economic status of dairy farmers [20].

Cost Benefit Ratio of Area Specific Mineral Mixture Supplementation

NIANP reported that the cost-benefit ratio is 1:8 in favour of ASMM supplementation. It was calculated by taking into account the cost of mineral supplementation and direct as well as indirect benefits in terms of reduced postpartum breeding period, increased milk yield, reduction in veterinary costs and additional number of calves in a productive life span of 10 years [10]. In another study, the benefit cost ratio of 3.55 vs 3.11was observed in support of ASMM supplementation [3].It was reported that the Cost Benefit ratio of supplementation of area specific mineral mixture and deworming was observed as 1:14.7 under farmer management practices [20]. Farmers can save Rs.200/cow/year by providing TANUVAS ASMM@50g/animal [4]. Several researches concluded that cost benefit analysis favoured supplementation of area specific mineral mixture in both dairy cows and buffaloes [3, 21, 22].

CONCLUSION

Area specific mineral mixture supplemented to dairy cows significantly improved its milk production, SNF content and reproductive performance. It is also economical as it provides only essential minerals required for the particular area. Regular supplementation of ASMM improves the economic status of the dairy farmers by enhancing health, production and reproduction of cattle. It is also imperative to create awareness among dairy farmers regarding the importance of mineral supplementation. Restoration of soil health, fertility and remineralisation of soil is viewed as a permanent solution to avoid mineral deficiency in plants and animals.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest

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REVIEW ARTICLE

Failed Back Surgery Syndrome: Current Treatment Strategies, Challenges and Future Direction- A Systematic Review

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ABSTRACT

In failed back surgery syndrome describe a collection of diseases characterised by recurrent low back pain following spine surgery, with or without a radicular component. Prevalence of failed back surgery syndrome is up to 40%.In this review we discuss the incidence and economic burden of this syndrome and study in different aetiologies, focus on causes and different evaluation and treatment options. There are various factors affecting to failed back surgery syndrome such as obesity, degenerative changes, economic factors etc. Evaluation of patients symptoms with the help of patients clinical history follow by clinical examination. failed back surgery syndrome is complex and difficult pathology. Its management should be multidirectional and special attention should be given to postoperative spinal imbalance. In current practices we refer anti-inflammatory drugs, repetitive surgery and physiotherapy treatment will show positive result. Challenges in failed back like pain, tingling sensations, numbness which can affect patients' ability to do daily activities. In future direction patient with the spine surgery have chances to produce symptoms again for that to educate patient about the condition and increasing the strength and stability will improve the patient condition. The purpose of this article is to review the literature on failed back surgery syndrome. the article selection process was systemic. the current review includes 11 articles. This systematic review summarizes the current literature on issues related with failed back surgery syndrome. In these articles is showing current practice in failed back syndrome and current issues in failed back surgery syndrome.

Keywords: Failed Back Surgery Syndrome, Physiotherapy, Exercise , Phsyical Therapy

INTRODUCTION

Failed back surgery syndrome (FBSS) is a term coined by North et al. in 1991 to describe a collection of diseases characterised by recurrent low back pain following spine surgery, with or without a radicular component. Follet and Dirks highlighted the term the fact that back surgery and recurrent back surgery were not necessarily the best solutions for back and leg pain. Until then, famous doctors would explain that the prior surgeon had conducted surgery at the incorrect level to ease symptoms, or that the type of surgery used was insufficient.[1] Failed back may occur due to mismatch between patients and surgeons' expectation prior to the surgery. There is also high quality evidences that medical and surgical management are limited. Low back pain is a prevalent ailment among people, with lifetime prevalence rates ranging from 60% to 85%. Back pain has the most elevated indirect cost among orthopaedic and chronic pain diseases, with an average estimate of 19.8 billion dollars. In recent years, however, the incidence of spine surgery in general and spinal fusion, particularly among adults, has increased significantly[2]. Nonetheless, it is widely known that the incidence of FBSS after lumbar laminectomy with or without fusion ranges from 10% to 40% [1]. In this review we discuss the incidence and economic burden of this syndrome and study in different etiologies, focus on causes and different evaluation and treatment options.

Etiology

Although the cause of FBSS is unknown, several investigations concur that it has a multifactorial origin and that the causative elements can be divided into three categories: preoperative, operative, and postoperative factors.

Preoperative Factors

Many preoperative factor like accuracy of diagnoses, socioeconomic, behavioural, and psychological factors determine the like hood of success of spinal surgery [2]. according to the accurate diagnosis of patient aetiology of pain, successful outcome of a surgical intervention is dependent. Accurate diagnosis is dependent on a thorough history, physical examination, and imaging [3]. Litigation and workers' compensation are two economic factors that may limit successful spinal surgery outcomes. These variables provide the confounding variable of secondary gain, which may detract from the patient's desire to improve. In nearly all outcome variables, including postoperative pain levels, postoperative opioid use, functional ability after surgery, including ability to work, and overall emotional well-being, patients receiving workers' compensation respond poorly to spine surgeries when compared to nonworkers' compensation patients [4-5].

Behavioural factors may have an impact on the outcome of spinal surgery. Smokers used more analgesics, had reduced walking capacity, and had a lower overall quality of life 2 years after surgery than non-smokers, according to a large prospective cohort research comprising 4,555 patients who had spine surgery for lumbar spinal stenosis [6]. Smoking is also linked to a higher likelihood of perioperative problems, such as poor wound healing, an increased risk of infection, and a higher rate of spinal fusion non-union [7-8]. These findings highlight the significance of encouraging people to change their behaviour in order to improve their health the patient's chances of a successful recovery. This concentration may be beneficial. be applied to a variety of aspects of life, including the upkeep of prior to bodily habituation and emotional disposition optimization to the operation. Psychological testing to identify these risk variables could be crucial in determining the predictive value of a patient's success following spinal surgery. Several studies have been conducted. Depression has been shown to be one of the most powerful predictive factors. signs of a poor prognosis following spinal surgery Patients who are depressed have more pain and weakness. as well as significantly lower rates of return to work as compared to in comparison to their non-depressed counterpart Depression, Anxiety, as well as other psychological and social factors, could have a role used to see if a patient is a good candidate for surgery on the spine [9-10].

Operative Factors

When compared to other factors such as psychological and social issues, poor surgical technique may be an equally important cause of FBSS, with the most common reason being failure to meet surgical goals with inadequate

decompression in the lateral recess or in neural foramens [11]. Inadequate decompression in the lateral recess, especially in the neural foramens, is the most common reason of poor surgical technique that leads to FBSS, accounting for 25%–29% of cases [12]. However, appropriate decompression might cause instability if more than 33% of the articular surface is removed bilaterally or 100% is removed unilaterally[11]. Notably, the rate of improper surgery is estimated to be between 2.1 and 2.7 percent [13]. The resultant limited exposure can result in a higher incidence when using minimally invasive and microscopic methods. Spinal instability increases with the number of surgeries, from 12% after the first reoperation to 50% after the fourth

Postoperative Factors

Back pain recurrence or inability to resolve might be the result of a variety of factors. Pain can be caused by a various factor. fresh beginning spinal degeneration or additional degeneration of the spinal column It might develop as a result of trauma or stress, or it can develop as a result of pathology. Back surgery frequently causes biomechanical changes in the area, resulting in higher load bearing on nearby structures. This can lead the onset of degenerative changes in the spine, both above and below the fusion. Sacroiliac joint (SIJ) illness is caused by fusion of the lumbar spine to the sacrum, as well as fusion of several segments [14-15]. Facet arthropathy is a type of degenerative alteration in the spine that can lead to new onset for aminal stenosis. Disc degeneration or a newly herniated nucleus pulposus, which can lead to central or foraminal stenosis, are examples of changes in the intervertebral discs. Epidural adhesions, which can occur after surgery and cause stenosis, can either cause or aggravate it.

Back surgery may alter biomechanics, resulting in greater tension on the prevertebral and postvertebral muscles that control spinal movement. Increased muscle tension can cause stiffness, inflammation, spasms, and exhaustion, all of which can cause pain in the paraspinal portions of the back [16]. During surgery, these muscles may be directly damaged as a result of intraoperative dissection and retraction. The likelihood of such an occurrence can be reduced by performing fusions through the anterior approach and using minimally invasive techniques. Nerve root irritation, on the other hand, could be a cause of FBSS. In 20%–36% of FBSS cases, nerve root entrapment due to epidural fibrosis is thought to be the cause or contributing factor for postoperative discomfort [13]. Excessive bleeding or severe root retraction can result in "battered root syndrome," which can induce radicular pain after surgery.

History and Clinical Examinations

History and clinical examination should search for “red flags” and “yellow flags” which are as follow:- The existence of "red flags" such as saddle (perianal/perineal) anaesthesia or paraesthesia, a recent development of bladder or anal dysfunction, and acute or worsening neurological deficiency in the lower limbs should be looked for during the history and clinical examination. Pain in people over 50 or under 20 years old, a history of cancer, constitutional symptoms like fever, chills, or unexplained weight loss, recent bacterial infection, intravenous drug abuse, immune suppression, and pain that persists while lying in the supine position all point to cancer or infection. A high risk of permanent nerve damage is indicated by significant muscle weakness or wasting, the loss of tendon reflexes, or the existence of a positive Babinski reflex.

"Yellow flags" or psychological stressors, as described by Nicholas A. S. Kendall [18], should be assessed throughout the history and clinical examinations. These psychosocial characteristics are associated with long-term chronicity and disability, and they have been linked to chronic pain syndromes in general and FBSS in particular [13]. Among them are: (1) fear-avoidance behaviour and decreased activity; (2) a negative attitude toward back pain, stating that it is harmful or potentially severely disabling; (3) a belief that passive, rather than active, treatment will be beneficial; (4) a tendency toward depression, low morale, and social withdrawal; (5) social or financial problems; and (6) salary or wages.

Laboratory Studies

A complete blood count, including a differential white blood cell count, erythrocyte sedimentation rate, and C-reactive protein level, should be performed in order to rule out postoperative infection. Plain radiographs with flexion–extension films and whole-spine anteroposterior and lateral views should be ordered to assess the surgery

site, spinal alignment, spinal imbalance, and degenerative alterations. Plain radiographs have a distinct advantage over other modalities in that they are dynamic and can identify an instability that would otherwise go undetected [19]. Because MRI offers the most accurate information on the cause of symptoms, it should be done with gadolinium enhancement to help distinguish between epidural fibrosis (which appears enhanced) and recurrent disc herniation (which does not show increased) [20]. Nerve root enlargement indicates a radicular source of symptoms, and when combined with recurrent disc herniation, it may necessitate FBSS surgical revision.

When instrumentation removal is being considered, computed tomography (CT), another effective technique for assessing spinal instrumentation-related problems, can assist characterise and quantify a fusion mass in an instrumented spine [21]. CT myelography can be utilised in patients who cannot have an MRI because it shows the compression of neural structures by bony components or others.

Treatment option

ConservativeTreatment

For patients suffering from low back pain with or without associated leg discomfort, therapy guidelines advocate conservative treatment as a first line choice. There is however little evidence so the added value of physiotherapy and recommendations for most pharmacologic treatments which are based on general trials including patients with chronic pain or patients with typical neurological syndromes such as diabetic polyneuropathy and post herpetic neuralgia and often restricted to 6 months follow-up. The first-line treatment for neuropathic pain, according to recently published treatment guidelines, is oral amitriptyline, gabapentin, or pregabalin [22]. For both acute and chronic lumbosacral radicular pain, an evidence-based practise guideline recommends conservative treatment. When a satisfactory result is not obtained, theinfusion of epidural corticosteroids could be explored – although should only be used in cases where the condition is (sub) acute. For radiofrequency treatment for the chronic type of the disease (pulsed) It is possible to consider the area next to the dorsal root ganglion [23].

Trials with spinal cord stimulation are particularly suggested for patients with therapy-refractory symptoms following initial therapeutic efforts [22]. First line treatment includes nonsteroidal anti-inflammatory drugs (NSAIDs) with oral NSAIDs is effective in chronic back pain [24]. Consumption of drugs can relieve pain temporarily but not solve the root cause of because pain in failed back is mostly cause due to biomechanical factors.

Type of Surgical Intervention

Repeated lumbosacral procedures are only successful in 20–30% of people with FBSS, therefore new surgery is rarely necessary. Re-operation should only be considered for FBSS patients who have pain that can be linked to a clearly visible and surgically treatable lesion. However, even after technically competent surgery, a chronic root or nerve lesion may continue to cause discomfort. Peripheral fibrosis surgery is rarely successful in providing long-term pain alleviation [25]. There is second repetitive surgery for failed back surgery syndrome which contain 20% of success chances, in third repetitive surgery have 15% of chances and in fourth failed back surgery have 5% of chances. Importantly, multiple studies have shown that neurostimulation is a good therapy option for FBSS patients who have had anatomically appropriate surgery but still feel pain during the last decade[26].

PhysiotherapyTreatment

Spinal cord stimulation (SCS)

Repeated lumbosacral procedures are only successful in 20–30% of people with FBSS, therefore new surgery is rarely necessary. Re-operation should only be considered for FBSS patients who have pain that can be linked to a clearly visible and surgically treatable lesion. However, even after technically competent surgery, a chronic root or nerve lesion may continue to cause discomfort. Peripheral fibrosis surgery is rarely successful in providing long-term pain alleviation [27]. Importantly, multiple studies have shown that neurostimulation is a good therapy option for FBSS patients who have had anatomically appropriate surgery but still feel pain during the last decade. Candidate with failed back surgery syndrome which undergo SCS should always undergo a test stimulation period of at least 2 weeks to asses their suitability for stimulation [28]. SCS relieve chronic pain for more than 30 years ,clinical result

support that gait control theory of pain as the basic concept which states stimulation of low threshold, large-diameter nerve fibre collateral in the dorsal column of spinal cord. Electrical stimulation at the level of spinal cord generated in respective dermatome [29]. Balneotherapy plus thermal aquatic exercise therapy was found to bemore effectivethan exercise therapy alone in POPS patients. Although exercise therapy was effective in improving lumbarflexibility, lifting capacity, general bodyperformance, activities of daily living, and psychological state, improving pain, and quality of life. isokinetic and dynamic lumbar stabilization exercises, may be equally effective in improving aspects of physical ability. Physiotherapy treatment help to manage pain for long term with the help of exercise and stimulations to the spinal cord. Although exercise therapy was effective in improving lumbar flexibility, lifting capacity, general body performance, activities of daily living, and psychological state, improving pain, and quality of life.

METHODOLOGY

We performed critical systematic review on failed back surgery syndrome : upcoming issue.

Search Strategy

The article selection process was systematic. Articles were selected relevant key words in PUBMED, GOOGLE SCHOLAR, MEDLINE, CINHAL database up to the february2022.the search term was “failed back surgery syndrome”, “physiotherapy in failed back surgery syndrome”,” rehabilitation in failed back surgery syndrome”, inpost operative back surgery and the search was limited to clinical human studies, clinical trials, reviews and metanalysis. We follow previous publish studies for a systematic review. The inclusion criteria of the review were 1) patient with failed back surgery syndrome 2) individual having back pain and radiating lower limb pain. 3) individual with intermittent claudication.

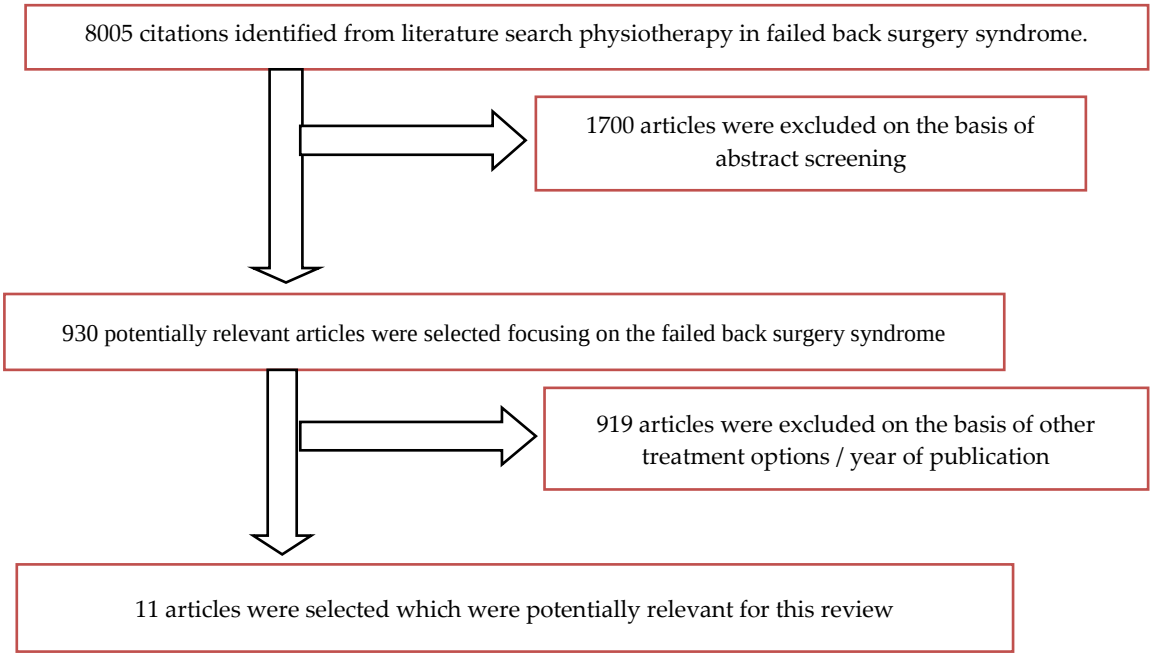
Study selection

A Systemic review was undertaken. We included studies published in English till 2022, which focused only on physiotherapy intervention in failed back surgery syndrome RCT, controlled trial, prospective study included. The participant had to be above 18 year age patient with failed back surgery syndrome. The intervention included conservative management, pharmacological management, consideration for surgical revision.

Data extraction

All steps in the selection and extraction processes were assessed independently by two reviewers. The titles and abstracts of the references are screened. The articles were reviewed according to the relevant topic and selected on the basis of inclusion criteria. The following data were extracted: study design, study population characteristic (inclusion / exclusion criteria), group(s) and sample size, rehabilitation in failed back surgery syndrome.

RESULT



This review represent the summary of article intervention on failed back surgery syndrome. The literature search produced article till year 2022. In Simon Thomson stud Failed back surgery syndrome – definition, epidemiology and demographics, concluded that FBSS is a complex and difficult pathology, and its accurate diagnosis is of utmost importance. Its management should be multidisciplinary, and special attention should be provided to cases of recurrent disc herniation and postoperative spinal imbalance. In Elif Yolgösteren. SevinçKülekçioğlu study the effectiveness of balneotherapy and thermal aquatic exercise in postoperative persistent lumbar pain syndrome. Concluded Balneotherapy plus thermal aquatic exercise therapy was found to be more effective than exercise therapy alone in POPS patients. Although exercise therapy was effective in improving lumbar flexibility, lifting capacity, general body performance, activities of daily living, and psychological state, improving pain, and quality of life.

In Ali YavuzKarahan,,NilaySahin and Akın Baskent study comparison of effectiveness of different exercise programs in treatment of failed back surgery syndrome: A randomized controlled trial, they concluded that Advanced exercise programs, including isokinetic and dynamic lumbar stabilization exercises, may be equally effective in improving aspects of physical ability and psychological outlook. Advanced exercise programs may be more effective than home exercises in FBSS. In Jens IvarBrox , Olav Reikera˚s, ØysteinNygaard Roger Sørensen ,et al studylumbar instrumented fusion compared with cognitive intervention and exercises in patients with chronic back pain after previous surgery for disc herniation: A prospective randomized controlled study concluded that The success rate was 50% in the fusion group and 48% in the cognitive intervention/exercise group. For patients with chronic low back pain after previous surgery for disc herniation, lumbar fusion failed to show any benefit over cognitive intervention and exercises.

In Byung-chul Son,Deok-ryeong Kim,2 Sang-won Lee study factors Associated with the Success of Trial Spinal Cord Stimulation in Patients with Chronic Pain from Failed Back Surgery Syndrome, concluded that Trial stimulation with paddle leads was more successful. If severe sensory deficits occur in the painful dermatomes in FBSS, trial stim-ulation were less effective.

DISCUSSION

Failed back surgery syndrome is condition get worsen day by day and becoming the major problem worldwide. Worldwide about 8.3% of peoples are affected and becoming increasing back pain is becoming a serious global problem. Due increase events of back pain incidences of surgery also increase .by increasing incidence of surgery incidence of failed back also increase because prevalence of failed back is 30-40% of number of surgeries. This systematic review summarizes the current literature on issues related with failed back surgery syndrome. In these articles is showing current practice in failed back syndrome and current issues in failed back surgery syndrome. There are very limited studies are showing proper treatment option for failed back surgery syndrome.

Current Treatment Strategies

Pain may generate after the spine surgery , with or without the radicular pain to the lower limb. It may control with the help of NSAIDs. If pain is uncontrollable to manage with NSAIDs and pain is chronic then repetitive surgery is the preferable option. In these syndrome hides the true issues concerning the mechanism of pain , physiotherapy will help to improve muscle strength and stability. Physiotherapy will help to manage the pain.

Challenges

After spinal surgery patient may face problems like pain, tingling sensations, numbness which can affect patients' ability to do daily activities. After surgery if patient failed to gain strength of the core muscles of the spine then they may limit themselves to work efficiently. Other major complication such as infection, blood clot, Dural tear, nerve injury and paralysis can also occur in some cases.

Future Directions

In back surgeries there are chances of reoccurring symptoms, to avoid that we have to focus onpatient education which is important process of informing a patient about the health matter. Core stabilization is the key to process of preventing failed back surgery and muscle strengthening and various ergonomic advicesuch as modified tasks according to the patient condition, correct and incorrect techniques that minimize the risk factor.

CONCLUSION

The systematic review has provided an overview of etiology, evaluation and management failed back syndrome. in summary failed back surgery syndrome is a complex and difficult pathology with multiple known causes and with largely unknown etiologies. An accurate diagnosis is most important and multidisciplinary management. In management conservating treatment as a first choice for pain with or without associated leg discomfort. In conservative treatment nonsteroidal anti-inflammatory drugs(NSAIDs) is effective. . Re-operation should only be considered for FBSS patients who have pain that can be linked to a clearly visible and surgically treatable lesion. In post operative patient there are possibilities of regeneration of pain after few months of surgery, hence they should go for the physiotherapy treatment to avoid repeat surgery. Physiotherapy treatment help to manage pain for long term and improve muscle performance. After spinal surgery patient may face problems like pain, tingling sensations, numbness which can affect patients' ability to do daily activities. Hence to reduce the pain, improve patient condition and to increase muscle strength we have to focus on patients education, core stabilization. Muscle strengthening and various ergonomic advice according to the patient condition.

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Table 1.

SR NO.	STUDY	AUTHOR	RESULT
1.	Failed back surgery syndrome – definition, epidemiology and demographics	Simon Thomson	FBSS is a complex and difficult pathology, and its accurate diagnosis is of utmost importance. Its management should be multidisciplinary, and special attention should be provided to cases of recurrent disc herniation and postoperative spinal imbalance
2.	The effectiveness of balneotherapy and thermal aquatic exercise in postoperative persistent lumbar pain syndrome	ElifYolgösteren · SevinçKülekçioğlu	Balneotherapy plus thermal aquatic exercise therapy wasfound to be more effective than exercise therapy alone inPOPS patients. Although exercise therapy was effective inimproving lumbar flexibility, lifting capacity, general body performance, activities of daily living, and psychologicalstate, improving pain, and quality of life.
3	Comparison of effectiveness of different exercise programs in treatment of failed back surgery syndrome: A randomized controlled trial	Ali YavuzKarahan,, NilaySahinand Akın Baskent.	Advanced exercise programs, including isokinetic and dynamic lumbar stabilization exercises, may be equally effective in improving aspects of physical ability and psychological outlook. Advanced exercise programs may be more effective than home exercises in FBSS.
4	Lumbar instrumented fusion compared with cognitive intervention and exercises in patients with chronic back pain after previous surgery for	Jens IvarBrox , Olav Reikera˚s, ØysteinNygaard Roger Sørensen ,et al	The success rate was 50% in the fusion group and 48% in the cognitive intervention/ exercise group. For patients with chronic low back pain after previous surgery for disc herniation, lumbar fusion failed to show any benefit over cognitive

	disc herniation: A prospective randomized controlled study		intervention and exercises.
5	Factors Associated with the Success of Trial Spinal Cord Stimulation in Patients with Chronic Pain from Failed Back Surgery Syndrome	Byung-chul Son, Deok-ryeong Kim, ,2 Sang-won Lee	Trial stimulation with paddle leads was more successful. If severe sensory deficits occur in the painful dermatomes in FBSS, trial stimulation were less effective
6	Interventional Pain Management for Failed Back Surgery Syndrome	ArifHussainDO,MichaelErdek MD	A multidisciplinary, comprehensive approach to FBSS treatment that involves exercise or physical therapy, psychological counseling, medication, and interventional procedures appears to be most effective.
7	Medical management of failed back surgery syndrome in Europe: Evaluation modalities and treatment proposals	G. Durand∗, J. Girodon , F. Debiais	An adapted multidisciplinary treatment strategy effective on this complex pain can only be proposed on the basis of this detailed assessment. Therapeutic classes or injections must be adapted to the predominant component of the pain(nociceptive orneuropathic) associated with rehabilitation and global psychosocial assessment and management

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RESEARCH ARTICLE

Effect of Integrated Nutrient Management on Growth Parameters of Bitter Gourd (*Momordica charantia*. L) Cv. Pattukottai Local

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ABSTRACT

An experiment on "Effect of integrated nutrient management on growth parameters of bitter gourd ((*Momordica charantia* L.) cv. Pattukkottai local" was conducted in the Alathur, Pattukkottai Taluk, Thanjavur District during January 2021. The experiment was conducted in Randomized Block Design with ten treatments and three replications. The treatments were application of organic manures *viz*., FYM @ 25 t ha^{-1},Vermicompost @ 5 t ha^{-1}, Neem cake @ 5 t ha^{-1} combined with or without consortium of biofertilizers @ 2kg ha^{-1} and RDF (20:30:60 Kg NPK ha^{-1}) in two levels (75 and 100 percent). The results of the above experiment revealed that the growth parameters *viz.,* Maximum vine length (165.90, 210.40 and 241.12 cm) at 45, 90 and 120 DAS respectively, Number of leaves per plant (260.55) and number of branches per plant (9.80) were recorded the maximum in the treatment which received the application of vermicompost @ 5 t ha^{-1}, consortium of biofertilizer @ 2 kg ha^{-1} and 100 per cent RDF (20:30:60 kg ha^{-1}).The least value for the growth parameters were observed in control when compared with other treatments.

Keywords: biofertilizer, Number of leaves per plant, growth parameters, FYM

INTRODUCTION

Vegetables are essential for a healthy diet. Bitter gourd is a native of tropical Asia particularly in the Indo Burma Region. It is widely grown in India, Indonesia, Malaysia, China and tropical America. The important bitter gourd growing states are Maharashtra, Gujarat, Punjab, Tamil Nadu, Kerala, Andra Pradesh, Odisha, Bihar and Assam.

Bitter gourd fruits are rich in Iron(1.8mg), rich in phosphorus (55mg/100g), Calcium (20mg/100g) and vitamin A (210/100g). Fruits are used after cooking and delicious preparation are made after stuffing and frying. Fruits have medicinal value and used for curing diabetes, asthma and rheumatism. Protein of bitter gourd inhibit the growth of HIV viruses in human cell cultures. Momorcidin alkaloid given the bitter taste to the fruit. The use of organic fertilizer in sustainable agriculture benefits farmers, growers, consumers and the environment in many ways. It improves the soils organic matter content. Vermicompost used for maintain soil pH in acidic soil. FYM used for soil fertility, reduce the dependence of synthetic fertilizers. Neem cake used as concentrated organic manure, control the spread of nematodes and plant parasites, (Meerabai *et al*,2007). Inorganic fertilizers like N, P and K were used for experiment. Biofertilizers can be expected to reduce the use of chemical fertilizers and pesticides. Through the use of biofertilizers, healthy plants can be grown, while enhancing the sustainability and the health of the soil.INM is a practice where all sources of nutrients namely organic, inorganic, biofertilizers can be combined and applied in soil, so that crop growth is enhanced and we can get good yield with quality product. INM is the maintenance or adjustment of soil fertility and plant nutrient apply at an optimum level to sustain desired crop productivity. It is low costand easy method to adopt. Considering the above point of view, the present investigation was carried out to study the effect of Integrated Nutrient Management on growth parameters of bitter gourd.

MATERIALS AND METHODS

A field experiment was conducted in a farmer's field at Alathur village in Pattukkottai Taluk, Thanjavur District, Tamil Nadu during January 2021. Bitter gourd cv. Pattukkottai Local was used for the experiment. The experiment was laid out in Randomized Block Design with ten treatments and three replications. The experiment was conducted by using various organic manures *viz*., FYM @ 25 t ha^{-1}, vermicompost @ 5 t ha^{-1} and neem cake @ 5 t ha^{-1} as basal along with recommended dose of inorganic fertilizers as 75 and 100 per cent (15:22.5: 45 $kgha^{-1}$ and 20:30:60 $kgha^{-1}$ respectively). Consortium of bio fertilizer (2 $kgha^{-1}$) was applied ten days after the incorporation of organic manures. In control, only FYM @ 25 t $ha^{-1}$was applied and no chemical fertilizers was applied. Bitter gourd seeds of Pattukkottai Local was sown in 30 cm^3 pits at a spacing of 2 x 1.5 m. Four seeds per pit was sown, later on thinned to two seedlings per pit. Nitrogen in the form of urea was applied in three split doses, one dose as basal, remaining dose was applied in fifteen and forty-five days. The full dose of phosphorus and potash were applied in the form of single super phosphate and muriate of potash as basal. Irrigation and weeding were done as per the requirement of the crop. The observations on growth parameters like vine length, number of leaves per plant and number of branches per plant were recorded. The data were analyzed statistically following the method suggested by the Panse and Sukhatme (1985)

RESULT AND DISCUSSION

Vine length was significantly enhanced by the application of (Vermicompost 5 t ha^{-1}+CBF 2 kg ha^{-1}+ 100% RDF) which recorded maximum vine length (165.90, 210.40 and 241.12 cm) at 45, 90 and 120 days after sowing respectively. It was followed by the treatment which received the application of FYM 25 t ha^{-1}+ CBF 2 Kg ha^{-1} + 100 % RDF and recorded (157.70, 202.00 and 231.52cm) at 45,90 and 120 days after sowing respectively. The vine length was found be minimum (107.95,150.57 and 178.25cm) at 45,90 and 120 days after sowing respectively were observed in the control. This might be due to the application of organic manures along with biofertilizers are necessary to increase the content of organic matter, maintain the nutrient balance and improve the physical and chemical properties of the soil. The similar findings were reported by Thiriveni *et al.* (2015) in bitter gourd .The number of leaves per plant was recorded the highest (260.55 cm) at 120days after sowing in the treatment applied with (Vermicompost 5 t ha^{-1}+CBF 2 kg ha^{-1}+100%RDF). This was followed by the treatment (FYM 25 t ha^{-1} + CBF 2 Kg ha^{-1} + 100 % RDF) which recorded (249.05 leaves) at 120 days after sowing. The least number of leaves (177.20 cm) at 120 days after sowing was registered in the control. This was due to the vermicompost which would have improved physical properties in the soil. Organic manure improves the soil physical condition and improves the soil. The similar findings were reported by Singh *et al.* (2012) in Tomatoand John *etal.* (2013) in Capsicum Number of branches

per plant were recorded the highest (9.80) in the treatment applied with (Vermicompost 5 t ha^{-1}+CBF 2 kg ha^{-1}+ 100% RDF). It was followed by the treatment which received the application of (FYM 25 t ha^{-1}+ CBF 2 Kg ha^{-1}+ 100 % RDF) which recorded (9.30), whereas the lowest number of branches per plant (6.10) was observed in the control. These might to be due to the combination of organic, inorganic and biofertilizers also recorded maximum number of branches per plant which helped the plants in better photosynthesis to attain vigour. The similar findings were reported by Prasad *et al.,* (2009) in bitter gourd.

CONCLUSION

Based on the present investigation, it could be concluded that the application of vermicompost (5 t ha^{-1}), consortium of bio fertilizer (2 kg ha^{-1}) along with 100 per cent RDF **(**20:30:60 kg ha^{-1}) was found to be beneficial in improving the growth parameters of bitter gourd.

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Table 1: Influence of Integrated nutrient management on growth parameters of bitter gourd.

Treatment details	Vine length (cm)			Number of leaves per plant	Number of branches per plant
	45 DAS	90 DAS	120 DAS		
T_1 – FYM 25 t + 100 % RDF	132.45	176.47	205.03	214.10	7.72
T_2 – VC 5 t + 100 % RDF	140.95	184.87	213.83	225.80	8.25
T_3 – NC 5 t + 100 % RDF	124.25	167.97	196.23	202.40	7.25
T_4 – FYM 25 t +CBF+ 75 % RDF	149.35	193.47	222.62	237.40	8.77
T_5 – VC 5 t + CBF +75 % RDF	157.65	201.97	231.49	249.00	9.28
T_6 – NC 5 t +CBF+ 75 % RDF	116.12	159.43	187.40	190.75	6.72
T_7 – FYM 25 t +CBF+ 100 % RDF	157.70	202.00	231.52	249.05	9.30
T_8 – VC 5 t + CBF +100 % RDF	165.90	210.40	241.12	260.55	9.80
T_9- NC 5 t + CBF +100 % RDF	116.15	159.47	187.43	190.90	6.76
T_{10}- Control	107.95	150.57	178.25	177.20	6.10
S.Ed	**3.95**	**4.13**	**4.10**	**5.60**	**0.21**
CD (P=0.05)	**7.90**	**8.22**	**8.24**	**11.22**	**0.45**

FYM-Farmyard manure, VC- Vermicompost, NC- Neem cake, CBF- Consortium of bio fertilizer, 75%RDF (15:22.5: 45 kg ha^{-1}) and 100% RDF (20:30:60 kg ha^{-1})

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RESEARCH ARTICLE

IoT Based GSM Module Integrated Continual 24 Hours Throb of the Heart Monitoring Structure

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ABSTRACT

In recent days, the cardiovascular disease problem has been so high in the entire world. Which is used to monitor the electrical activity of the heart along with heart rate and oxygen level. To make the system real-time, a GSM module to upload data on the cloud is incorporated. By monitoring these biomedical data doctors can easily support the patients for medication based on the severity. If a patient feels an abnormal condition and wants to check current data for that purpose LED display is used.

Keywords: Holter monitoring, Heart diseases, ECG signal, Pulse sensor, OLED Display.

INTRODUCTION

A Holter monitor is a small, battery-powered medical device that measures your heart's function, such as heart rate and rhythm. Holter monitoring is a continuous biomedical data test to record your heart's rate and heart rhythm for around 24 hours. The Holter monitor device is also called ambulatory electrocardiography. These devices can be used to measure heart function for longer periods. Cardiovascular disease such as heart attack, stroke, and hypertension, is caused by disorders of the heart and blood vessels. The ECG signals are acquired directly through the ECG's three-electrode sensor and then transferred to an Android Smartphone through Bluetooth. The algorithm for possessing ECG signals is implemented on to discover aberrant symptoms, classify the patient's ECG data[11]. Nowadays, Holter monitors available in the market have the facility of only monitoring ECG. In this paper, we can

include three more parameters like heart rate and oxygen (SPO2) Module, GPS & GSM module, and vibration sensor. Holter monitors don't give real-time results. It may take one or two weeks. So, in this project, we made the system in real-time and got results earlier. Experiments show that the proposed SQA method outperforms existing methods based on morphological and RR interval features, as well as machine learning approaches, in recognizing the unacceptable quality of ECG data [12].The IoT-based gadgets are more human-friendly than the Holter Monitor because they have fewer cords and smaller sizes, and they create fewer disturbances to patients' everyday activities. However, the widespread use of IoT-based devices has resulted in a significant rise in ECG data, posing a significant challenge to ECG interpretation [14]. As well as, if a patient wants to see their current biomedical data, by using an old patient can see current biomedical data. This device can help in reducing the number of deaths by this type of disease.

Monitoring the health conditions of a patient remotely needs a lot of devices to be connected with them and it is not affordable for a common person. We provide a brief overview of IoT solutions in health care, beginning with early health monitoring systems based on wearable sensors and progressing to a discussion of the newest trends in fog/edge computing for smart health [13]. In actuality, several efforts to automate and improve patient monitoring systems have already been made. Previous efforts, on the other hand, had considerable drawbacks and lacked the real-time aspect required for chronic conditions [15].The portable device discussed here will continuously monitor the patient and inform their status to the respective authority and also to the doctors under whom this patient is taking medication. In This device, the data is extracted from the sensor modules and stored in an SD card. To make the system real-time, a Wi-Fi module is used to upload data on the cloud. By monitoring at least around 24 to 48 hours of this biomedical data doctors can diagnose disease much earlier. If a patient like to feel abnormal and wants to check current data for that purpose LED display is used. The proposed system is compact, low cost, and real-time.

LITERATURE SURVEY

Prachi Patil et al [1] has proposed a system to design the patient's health monitoring using heartbeat, blood pressure, glucose level, oxygen level. It uses the IoT cloud to store the data and is used to access by the doctors. The heartbeat sensor detects the rate of heartbeat in most adults who have a resting heart rate between 60 and 100bpm. And the heartbeat is measured in seconds. Heart rate, also known as pulse, is the number of times a person's heartbeats per minute. Normal heart rate varies from person to person, but a normal range for adults is 60 to 100 beats per minute. PrachiKamble et al [2] proposed the system of Electrocardiogram to record the patient's heartbeat and pulse rate. It obtains long time monitoring. The output is shown in the LCD and a web interface is used to acquire the ECG information. The electrical signal from your heart to check for different heart conditions. Electrodes are placed on your chest to record your heart's electrical signals, which cause your heart to beat. ECG can store the data and can read it in the future. The long term monitoring can be done and easily can store the informa Mateo Sokačet al [3] proposed a system that detects the information generated by the Holter device and can monitor their heart for a longer time. This system has been proposed in the long term and can easily be accessible for every situation and hold the device for a longer time and introduce a smaller device that is useful for future life hacks. The hoter device was introduced in this process. The process is used to check your heart's rhythm and electrical activity. Sensors attached to the skin are used to detect the electrical signals produced by your heart each time it beats.

Sharvari M. Kallole et al [4] has proposed a system that continuously transmits and monitors ECG heart rate and oxygen percent present in the blood. The data are extracted from the module and stored in the SD card through the SD card module. The real-time system uses the Wi-Fi module to upload the cloud. If a patient feels normal and wants to check current data for that LED display is used. SD cards store the information and it has the capability to store it in the cloud storage for safety measurements. SD card has a particular set of storage to encode every information and decode at every time. Lamia Nabil Mahdy et al[5] has presented a small ECG HOLTER device that was developed to detect arrhythmias in real-time based on an android mobile application. The ECG signals are obtained through ECG's three-electrode sensor then transmitted through a Bluetooth module to Android smartphones. This analyzes and

classifies the patient's ECG data to detect abnormal signs. This proposed work has introduced the three variant sensors which will detect by the particular role by LCD to check the health state. John T. Philbrick, MD et al[6] have proposed the day-after-day variability of a heart condition and heart muscle anemia detected by mobile cardiogram observance is also appreciable in a private patient. Caution should therefore be employed in deciphering serial tests. Mobile cardiogram monitoring with diary correlation permits documentation of internal organ arrhythmias inflicting symptoms, however, the diagnostic yield is low unless symptoms are unit frequent. The part shows the condition of the Heart and the flow of Oxygen level. Tadashi Suzuki, M.Det al [7]. Holter observance was related to a sensitivity of sixty-seven % and a specificity of eighty % for identification of viscus involvement in patients with general pathology. Our findings suggest that 24-h Holter observance provides a convenient and cheap means of noninvasive screening for viscus involvement in generalized pathology, even in inpatients. This work shows the percentage of heartbeat, oxygen level, blood flow.

Existing solution

The proposed system named IoT-based portable device Monitor gives appropriate data. The major parameters considered to make a complete Holter monitor are heart rate, ECG signal, and oxygen percentage in blood. The biomedical data of heart rate and ECG signals are proper. The system is very lightweight and low cost. We are storing biomedical data on an SD card as well as displaying it on an OLED display. Data stored in SD cards will help doctors to diagnose diseases of patients and OLED displays will give the current status of parameters to patients. This data can be sent on Blynk for real-time data access. The portable patient monitoring device is used to monitor the status of patients health condition and the information is stored in the cloud via a GSM module sent to the physician for further advice and medication, and also if an abnormal condition arrives the information will be sent to ambulance and physician for further care of patients. an oximeter, pulse sensor, ECG monitor, and Vibration sensors are used to check the health condition of the patients. We claim that from the sensors, the data obtained are stored in the cloud using the IoT concept and the output of sensors is processed to find the normal and abnormal conditions of the patients based on the predefined threshold values. The information about the patient's health condition will be displayed in the LCD and an alert will be given if an abnormal condition arrives messages will be sent to the caretaker, physician, and ambulance based on the condition of the patient which has arrived from the diagnosis part of the device.

Proposed method

The proposed system is a complete Holter monitor, which is used for cardiac monitoring. The Holter monitor is manually used for monitoring ECG, but in this system, we included three more parameters. Heart rate and oxygen percentage present in the blood are the major parameters and are much important in the diagnosis process. Also includes three modules to calculate heart rate, ECG signal, and oxygen percentage in blood. To compute a patient's heart rate, the system can detect QRS complexes and count heartbeats for one minute. In the smart ECG Holter, a mechanism for robustly classifying ECG into one of three major kinds of arrhythmias was devised[11]. There are many different ways to calculate heart rate, and in this project, we built one algorithm which takes heartbeats for 15 sec and converts it to BPM. The output of the ECG module is an analog signal. So, we can directly store ECG into an SD card and display it on OLED. Pulse Oximeters are used to measure oxygen percentage in blood. The suggested quality-aware ECG telemetry system also saves energy consumption by broadcasting good ECG signals and placing IoT devices into sleep mode for poor ECG signals, according to real-time evaluation results [12]. A data cleansing module and a heartbeat classification module make up the framework. It takes raw ECG readings from various IoT devices as input and produces predictions for individual heartbeats as output [14]. A telemedicine system is a highly effective approach to connect patients with their doctors at any time and from any location. In reality, this proposed solution makes use of IoT-based technology [15].The main aim of this paper is to make Holter monitors lightweight and low cost and we could take the result earlier. The ECG module has electrodes patients need to wear for measuring ECG. Electrodes of ECG sensors cause skin penetration and patches. We can use this system in different kinds of ways like remote health monitoring and wearable health monitoring and so on. It alerts any kind of abnormal condition in the patient and simultaneously forwards the information to the registered mobile number. If

any find abnormal conditions for heart rhythm more than 100 beats per minute and below 60 beats per minute. Then, the vibration sensor is activated and transfers the messages through GPS and GSM modules. GPS is used to detect the location of the accident and GSM sends the message to the concerned registered mobile number. These can be applied in all kinds of network available areas. This helps in giving the medical treatment as soon as any kind of critical stage occurs as the location can be found easily. One advantage for sophisticated security at mobile numbers can be changed at any time and alert messages to mobile phones for remote information.

Block diagram of the invention

Basically, patients may be asked to wear a portable device to check if the patient has slow, fast, or irregular heartbeats. Considering not only the heart but also the whole body for diagnosis, it may be easy to detect the abnormalities in a patient's body. In this device, extracting ECG signal from AD8252 ECG module, Pulse signal from Tech leads pulse sensor, GSM module, vibration sensor and oxygen concentration in blood by using (MAX 30100) SPO2 sensor module is placed. These sensor components are used to acquire signals and given to the Arduino for further processing. All the information from the sensors is stored, further, it is sent to the doctor for diagnosis purposes and if the patient wants to see their current reading so that the signals are displayed on an OLED display.

Circuit diagram

Figure 2: Circuit schematic of the invention with sensor modules

Circuit diagram of the invention

The proposed system is a complete patient monitor, which is used for cardiac monitoring. This device is basically used for monitoring health conditions like ECG, Heart rate, and oxygen percentage present in the blood are the major parameters and are much important in the diagnosis process. The system includes three modules to calculate heart rate, ECG signal, and oxygen percentage in blood. An Arduino microcontroller is used to acquire and process the information from the modules. There are many different ways to calculate heart rate, and in this project, we built one algorithm which takes heartbeats for 15 sec and converts it to BPM. The output of the ECG module is an analog signal. So, we can directly store ECG and display it on OLED.

CONCLUSION

The proposed system named IoT-based portable device Monitor gives appropriate data. The major parameters considered to make an innovative Holter monitor are heart rate, ECG signal, and oxygen percentage in blood. The biomedical data of heart rate and ECG signals are proper. The system is very lightweight and low costs as well as we are using predicament situations. We are storing biomedical data on an SD card as well as displaying it on an OLED display. Data stored in SD cards will help our doctors to diagnose diseases of patients and OLED displays will give the current status of parameters to patients. Furthermore, a vibration sensor is activated and transfers the messages through the GPS and GSM modules. Any kind of critical stages occurred as the location can be found easily.

RESULT

The ECG sensor module AD8232 produces an analogue signal. For ECG and other biopotential measurement applications, the AD8232 is an integrated signal conditioning block. It's made to extract, amplify, and rectify tiny biopotential signals in noisy environments, such as those caused by mobility or remote electrode placement. An ECG sensor module is used to display the ECG signal[4]. Sensors are used to obtain various types of biological data from patients. The Arduino is used to control modules and to perform additional processing. The data is simultaneously stored in the SD card and displayed on an OLED display. The BPM value of the pulse and the percentage of oxygen in the blood are kept in a single SD card file. We can easily send data to the cloud using online IoT platforms like Blynk and Ubidot, making the system real-time. These papers are intended to be low-cost and lighter-weight than

the Holter monitor presenting market. Because there were no incorrect readings in the heart rate and ECG signal, this system produced accurate findings. However, due to the presence of carbon monoxide, it's possible that we'll acquire erroneous pulse oximeter data. information saved on an SD card [4].

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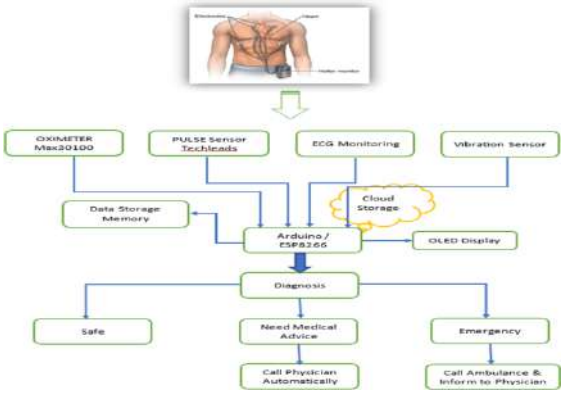

Figure 1: Block diagram of the invention

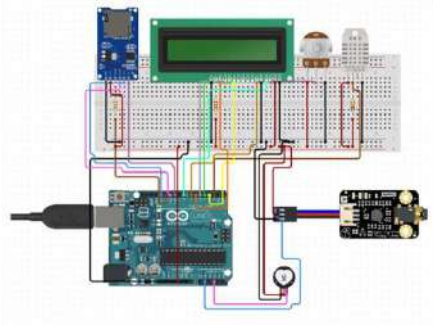

Figure 2: Circuit schematic of the invention with sensor modules

Fig -3: Heart rate and Oximeter readings

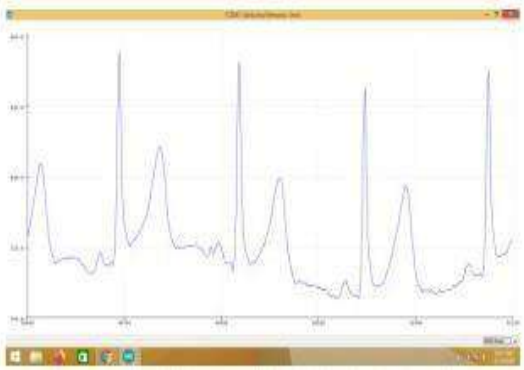

Fig -4: Analog output of ECG sensor module

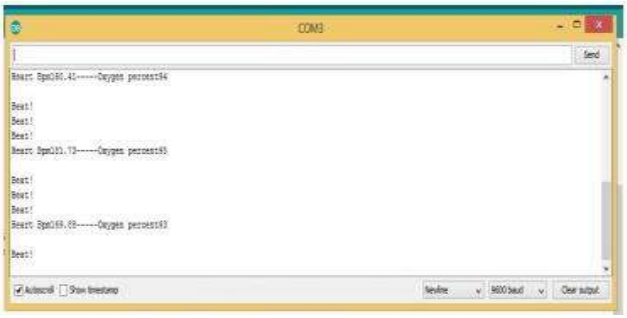

Fig -5: Output of pulse Oximeter

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RESEARCH ARTICLE

n-Quasinormal Operator in Minkowski Space

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ABSTRACT

In this paper, we have investigated the bounded linear operator T in Minkowski space with the property that $T^{\sim}T^n$ commutes with T. Furthermore, the sum and product of such operators have been discussed. It is also discussed that an operator satisfies this property under certain conditions on its real and imaginary parts.

Keywords: Normal; m-symmetric; quasinormal; operators; Minkowski space; generalized inverse.
AMS Subject Classification:15A09, 46C20, 47A07.

INTRODUCTION

The Minkowski inner product on ordered n-tuples of complex numbers is defined by $(u, v) = [u, Gv]$, where $u, v \in C^n$and G is the Minkowski metrictensor given by $Gv = v_0, -v_1, -v_2, \dots, -v_{n-1},forv = v_0, v_1, v_2, \dots, v_{n-1},$. A spacewith Minkowski inner product is called a Minkowski space M . The concept of Minkowski space has its origin in the theory of polarization ofl ight. $T \in C^{n\times n}$ is given by $T^{\sim} = GT^*G$, $T^*$is the Hermitian adjoin to f T in Hilbert space H. And $T^{\sim}$is adjoint of T in Minkowski space M. And in Minkowski space, Minkowski metric matrix is $G = \begin{bmatrix} 1 & 0 \\ 0 & -I_{n-1} \end{bmatrix}$ and $G^2 = I, G = G^*$

Definition1.1. An operator T in Minkowski space M is called Normal $T^{\sim}T = TT^{\sim}$

Definition 1.2. An operator T in Minkowski space M is called quasi normal if $T(T^{\sim}T) = (TT^{\sim})T$

Definition1.3. An operator T in Minkowski space M is called hyponormal if $T^{\sim}T \geq TT^{\sim}$
Definition 1.4. Anoperator T in Minkowski space M is called n-normal if
T^n is a normal operator. This is equivalent to $T^{\sim}T^n = T^nT^{\sim}$.

These operators have been studied in [1]. n-power quasi normal if$(T^{\sim}T)T^n = T^n(T^{\sim}T)$.
In this paper, we introduce and study a class of n-power quasi normal operators.

Definition 1.5. An operator T in Minkowski space M is called n-quasi normal operator if $(T^{\sim}T^n)T = T(T^{\sim}T^n)$.
For n-quasi normal operators S, $T \in L$ (M) with $\boldsymbol{ST = TS = T^{\sim}S = ST^{\sim} = 0}$,Weshowthat$S + T$ is n-quasi normal. It is proved that the product of n-quasi normal operator satisfying some commuting conditions is n-quasi normal. We also discuss conditions on ann-quasi normal operator implying normality or hyponormality in Minkowski space. For self ad joint operator A and B in L (M) , it is discussed that $T = A+IB$ is n-quasi normal under certain commuting conditions on A and B . Some counter examples are also given at appropriate places

n-power quasinormal operator in M

It is well know that a quasinormal operator on a finite dimensional space isnormal. Andalson-power quasi normal operator need not be n-quasi normal.

Definition 2.1. An operator Tin Minkowski space M is called n-power quasi normal, if$(T^{\sim}T)T^n = T^n(T^{\sim}T)$
Theorem 2.1. If T and S in Minkowski space Mare n-quasi normal operator and $TS = 0 = ST = T^{\sim}S = ST^{\sim}$, then T+S is n-quasi normal

Proof. $((T+S)^{\sim}(T+S)^n)(T+S)$
$=(T^{\sim}+S^{\sim})(T^n+\binom{n}{1}T^{n-1}S\binom{n}{2}T^{n-2}S^2+\cdots+\binom{n}{n-1}TS^{n-1}+S^n)(T+S)$
$=(T^{\sim}T^n+S^{\sim}S^n)(T+S)$
$= T^{\sim}T^{n+1}+S^{\sim}S^{n+1}$

Now,

$(\boldsymbol{T+S})((\boldsymbol{T+S})^{\sim}(\boldsymbol{T+S})^{\boldsymbol{n}})$
$= (T+S)(T^{\sim}+S^{\sim})(T^n+\binom{n}{1}T^{n-1}S+\binom{n}{2}T^{n-2}S^2+\cdots+\binom{n}{n-1}TS^{n-1}+S^n)$
$= (T+S)(T^{\sim}T^n+S^{\sim}S^n)$

Since T and S are n-quasi normal operators we have

$$((T+S)^{\sim}(T+S)^n)(T+S) = (T+S)((T+S)^{\sim}(T+S)^n)$$

Hence *T*+ *S* is n-quasi normal

The following discusses the conditions for product of two n-quasi normal operators to be n-quasi normal.

Theorem 2.2. If T and S in Minkowski space Maren-quasi normal and $TS = ST, T^{\sim}S = ST^{\sim}$, then TS is n-quasi normal.

Proof. $((TS)^{\sim}(TS)^n)(TS)$
$= (S^{\sim}T^{\sim})T^{n+1}S^{n+1}$
$= S^{\sim}S^{n+1}T^{\sim}T^{n+1}$

Since S and T are n-quasinormal,$(TS)((TS)^{\sim}(TS)^n)$
$= TSS^{\sim}S^nT^{\sim}T^n$
$= \mathbf{S^{\sim}S^{n+1}T^{\sim}T^{n+1}}$

$((TS)^{\sim}(TS)^n)(TS)$
Hence TS is a n-quasinormal operator.

Corollary 2.1. If Tin Minkowski space M is n-quasinormal and S is normal with TS=ST, then TS is n-quasi normal.

Theorem 2.3. If T in Minkowski space M is n-quasi normal, then $N(T^n)= N(T^k)$ for each k≥n.
Proof. Since T is n-quasi normal$(T^{\sim}T^n)T = T(T^{\sim}T^n)$.
Suppose $T^{n+1}(x) = 0$, then $(T^{\sim}T^n)Tx = 0$.
Thus $T(T^{\sim}T^n)x = 0$
So $< T(T^{\sim}T^n)x, y >= 0$, for each y∈H.
Thus$< (T^{\sim}T^n)x, T^{\sim}y >= 0$, for each y∈H.
By taking $y=T^nx$ we have$\|(T^{\sim}T^n)x\| = 0$.
Thus $T^{\sim}T^n(x) = 0$
By the Similar arguments we see that $T^nx = 0$.Thus $N(T^n) = N(T^{n+1})$

Now result follow as Tisk-quasinormal for each k≥n.

Theorem 2.4. If T in Minkowski space M is n-quasi normal and S is unitary equivalent to T , then S is n-quasi normal

Proof. Since S is unitary equivalent to T, $S = UTU^{\sim}$for some unitary operator U. Thus $(S^{\sim}S^n)S = U(T^{\sim}T^n)TU^{\sim}$and
$\mathbf{S(S^{\sim}S^n) = UT(T^{\sim}T^n)U^{\sim}.}$

Since T is n-quasi normal,$(S^{\sim}S^n)S = S(S^{\sim}S^n)$.
Hence S is n-quasinormal.

Theorem 2.5. If T in Minkowski space M is n-quasi normal and n-normal, then $T^{\sim}$ is n-quasinormal.

Proof.$((T^{\sim})^{\sim}(T^{\sim})^n)T^{\sim} = (T(T^nT^{\sim}))^{\sim} = (T(T^{\sim}T^n))^{\sim}$.
$= ((T^{\sim}T^n)T)^{\sim} = ((T^nT^{\sim})T)^{\sim} = T^{\sim}((T^{\sim})^{\sim}(T^{\sim})^n)$.
Hence $T^{\sim}$is n-quasinormal.

Theorem 2.6. If Tin Minkowski space M is n-quasinormal and n-normal, then T is k-quasi normal for each k≥n.
Proof. Since T is n-quasi normal, $(T^{\sim}T^n)T = T(T^{\sim}T^n)$. So $T^{\sim}T^{n+1} = TT^{\sim}T^n$.So T is n –quasi normal,$T^{\sim}T^{n+1} = TT^nT^{\sim}$.Thus T is (n+1)-normal. Hence T isk-quasi normal for each k≥n. □

It is well know that a normal operator is quasinormal. Following is natural binomial expansion of $(A+B)^n$ for n≥5
Lemma 2.1. Let A,B in Minkowski space M be such that $A^kB= BA^k$, $B^kA=AB^k$ for k=2,3 and $(AB)^2=(BA)^2$.

Then
$(\mathbf{A}+\mathbf{B})^{\mathbf{n}} = \sum_{\mathbf{k}=0}^{\mathbf{n}} \binom{\mathbf{n}}{\mathbf{k}} \mathbf{A}^{\mathbf{n}-\mathbf{k}}\mathbf{B}^{\mathbf{k}}$,
for $\boldsymbol{n} \geq \mathbf{5}$

Proof. Since $A^kB=BA^k$, $B^kA=AB^k$ for k=2, 3 and $(AB)^2=(BA)^2$, we get $(A+B)^3$ $=A^3+2A^2B+2AB^2+ABA+BAB+B^3$

$(A+B)^4 =A^4+4A^3B+4A^2B^2+4AB^3+2(AB)^2+B^4$.

Hence

$(A+B)^5=A^5+5A^4B+10A^3B^2+10A^2B^3+5AB^4+B^5$. Since A and B

Commute with each termin expansion of $(A+B)^5$.

Thus
$(A+B)^n = \sum_{k=0}^{n} \binom{n}{k} A^{n-k}\, B^k$
for all n ≥ 5

Theorem 2.7. Let T = A + i B in Minkowski space M be such that A and B are self adjoint. If $B^kA= AB^k$, $A^kB= BA^k$, for k = 2, 3 and$(AB)^2=(BA)^2$,thenTisn-quasinormalforeachn

Proof. Consider, $T^{\sim} = GT^*G$
$=G(A+iB)^*G$
$=G(A-iB)G$
$=GAG-iGBG$
$=A^{\sim}-iB^{\sim}$ Since A and B are m-symmetric.
$=A-iB$

Now, $(T^{\sim}T^n)T=(A-iB)(A+iB)^n(A+iB)$
$=(A-iB)(A+iB)\ (A+iB)^n$
$=(A^2+B^2)(A+iB)^n$ By Lemma
$= (A^2+B^2)\left(\sum_{k=0}^{n} \binom{n}{k} A^{n-k}\, B^k\right)$

$= \left(\sum_{k=0}^{n} \binom{n}{k} A^{n-k+2}\, B^k\right) + \left(\sum_{k=0}^{n} \binom{n}{k} A^{n-k}\, i^K (B^{k+2})\ \right)$

$T(T^{\sim}T^n) =(A+iB)(A-iB)(A+iB)^n$
$=(A^2+B^2)(A+iB)^n= (A^2+B^2)\left(\sum_{k=0}^{n} \binom{n}{k} A^{n-k}\, B^k\right)$

$$= \left(\sum_{k=0}^{n} \binom{n}{k} A^{n-k+2} B^k \right) + \left(\sum_{k=0}^{n} \binom{n}{k} A^{n-k} i^K (B^{k+2}) \right)$$

Thus $(T^{\sim}T^n)T = T(T^{\sim}T^n)$

Condition simplying normality

We discuss results pertaing to ann-quasi normal operator to be a normal operator.

Theorem3.1. If T in Minkowski space M is n-quasi normal operator and N(T˜)⊂N(T), then T is normal.

Proof. Since T is n-quasinormal, $(\boldsymbol{T}^{\sim}T - T\boldsymbol{T}^{\sim})T^n = 0$.

Thus $(T^{\sim}T - TT^{\sim})T^{n-1}y = 0$
For each $y \in R(T)$.
Let $x \in R(T)^{\perp} = N(T^{\sim})$.
Then $x \in N(T)$.
Hence $(T^{\sim}T - TT^{\sim})T^{n-1}x = 0$.
Thus $(T^{\sim}T - TT^{\sim})T^{n-1} = 0$.

Hence T is n-1 quasi normal. Continuing this way, we get T is normal.

Corollary 3.1. If T in Minkowski space M is n-quasi normal with R(T)= H, then T is normal.

Theorem 3.2. If T in M in kowski space M is n-quasi normal and T+λ is n-quasi normal for some real $\lambda \neq 0$, n≥1 then T is normal.

Proof. Since T+λ is n-quasi normal,

$(T+\lambda)^{\sim}(T+\lambda)^n)(T+\lambda) = (T+\lambda)((T+\lambda)^{\sim}(T+\lambda)^n)$.
Thus $T^{\sim}(T^n + n\lambda T^{n-1} + \binom{n}{2}\lambda^2 T^{n-2} + \ldots + \lambda^n)(T+\lambda)$
$+\lambda((T^n + n\lambda T^{n-1} + \binom{n}{2}\lambda^2 T^{n-2} + \ldots + \lambda^n)(T+\lambda)$
$= (T+\lambda)T^{\sim}T^n + n\lambda T^{n-1} + \binom{n}{2}\lambda^2 T^{n-2} + \ldots + \lambda^n)$
$+\lambda(T+\lambda)(T^n + n\lambda T^{n-1} + \binom{n}{2}\lambda^2 T^{n-2} + \ldots + \lambda^n)$.

Which implies that
$T^{\sim}(T^n + n\lambda T^{n-1} + \binom{n}{2}\lambda^2 T^{n-2} + \ldots + \lambda^n)T$ 2
$= TT^{\sim}(T^n + n\lambda T^{n-1} + \binom{n}{2}\lambda^2 T^{n-2} + \ldots + \lambda^n)$.
So$(T^{\sim}T^{n+1} + n\lambda T^{\sim}T^n + \binom{n}{2}\lambda^2 T^{\sim}T^{n-1} + \ldots + \lambda^n T^{\sim}T)$
$= (TT^{\sim}T^n + n\lambda TT^{\sim}T^{n-1} + \binom{n}{2}\lambda^2 T^{\sim}T^{n-2} + \ldots + \lambda^n TT^{\sim})$
Now using the quasinormality of T we get $T^{\sim}T = TT^{\sim}$.
Thus T is normal. □

Every quasi normal operator is hyponormal. Under some condition, ann-quasinormal operator is hyponormal.

Theorem 3.3. If T in M in kowski space M is ann-quasi normal operator, and R(T)=R(T^n), then T is hyponormal.

Proof. Let $x = u+v$ $H=N(T^{\sim})+R(T)$. **Suppose** V_n $R(T)$ **be such that** $V=\lim_{n\to\infty} V_n$

Let $D=T^{\sim}T-TT^{\sim}$.Since T is n-quasi normal.

$DT^n=0.\langle Du,u\rangle = \langle T^{\sim}T(u),u\rangle = \|Tu\|^2$.

For $y\in H,\langle y,Dv\rangle = \lim_{n\to\infty}\langle y,Dv_n\rangle =0$. Thus $Dv=0$. Therefore

$\langle Dx,x\rangle = \langle Du,u\rangle = \|Tu\|^2 \geq 0$ foreach $x \in H$. Hence T is hyponormal. □

Corollary 3.2. If T in M in kowski space M is ann-quasi normal operator on afinite dimensional Hilbert space with R(T)=R(T^n), then T is normal.

Theorem3.4. If T in M in kowski space M is ann-quasi normal and 2-normal ,then T is normal.

Proof. $(T^{\sim}T-TT^{\sim})^2=(T^{\sim}T)^2-T^{\sim}T^2T^{\sim}-(TT^{\sim 2}T+(TT^{\sim})^2$

$=(T^{\sim}T)^2-(T^2T^{\sim})^2-(T^{\sim})^2T^2+TT^{\sim}TT^{\sim}$

$=(T^{\sim})^2T^2-(T^2T^{\sim})^2-(T^{\sim})^2T^2+T^{\sim}TTT^{\sim}$

$=(T^{\sim})^2T^2-(T^2T^{\sim})^2-(T^{\sim})^2T^2+T^2(T^{\sim})^2=0$

Hence $T^{\sim}T-TT^{\sim}=0$

Theorem3.5. If T in M in kowski space M is ann-quasi normal and 2-normal, then T is (n-1)-quasi normal.

Proof. Since T is n-quasi normal and n-normal,

$T^{\sim n-1}(T^{\sim}T-TT^{\sim})^2T^{n-1}$

$=T^{\sim n-1}(T^{\sim}T)^2T^{n-1} - T^{\sim n-1}T^{\sim}T^2T^{\sim}T^{n-1} - T^{\sim n-1}T(T^{\sim})^2TT^{n-1} +$

$T^{\sim n-1}(TT^{\sim})^2T^{n-1}$

$=T^{\sim n}TT^{\sim}T^n-T^{\sim n}T^2T^{\sim}T^{n-1}-T^{\sim n-1}T(T^{\sim})^2T^n+T^{\sim n-1}TT^{\sim}TT^{\sim}T^{n-1}$

$=T^{\sim n+1}T^{n+1}-T^{\sim n}T^2T^{\sim}T^{n-1}-T^{\sim n-1}T(T^{\sim})^2T^n+T^{\sim n-1}TT^{\sim}TT^{\sim}T^{n-1}$

$=T^{\sim n+1}T^{n+1}-T^{\sim n+1}T^{n+1}-T^{\sim n+1}T^{n+1}+T^{\sim n+1}T^{n+1}=0$

Thus $T^{\sim n-1}(T^{\sim}T-TT^{\sim})^2T^{n-1}=0$. Hence $(T^{\sim}T-TT^{\sim})T^{n-1}=0$. Thus

T is(n-1)-quasinormal. □

Example 3.1. *Let* $T=\begin{pmatrix}2 & 1\\ 0 & -2\end{pmatrix}$ $0\ -2$

Here T is 2-quasi normal and 2-normal, But T is not quasi normal. Hence If Tin M in kowski space M is (n − 1) quasi normal and 2-normalis not always n quasi normal.

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RESEARCH ARTICLE

Postmillennial Indian Society: An Ocular Inspection

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ABSTRACT

Graphic novel – a term coined by Rich Kyle in 1964 and popularized by Will Eisner in his work 'A Contract with God and Other Tenement Stories' in 1978 is a literary and artistic style that deals with the combination of pictures or images and words to tell a narrative or dramatise a subject. Sequential art in India has its origin in late 1950s with the reproduction or translated version of Phantom, Mandrake and Tarzan from the West. Since then, the medium or format has been embraced by a lot of pioneers in India. This paper focuses on the visual turn that Indian graphic novel has taken in their portrayal and depiction of postmillennial issues such as the Emergency episode in the 1970s in India, and traditional marriage ideals of Indian society. By analyzing one short graphic narrative 'The Photo' and excerpts from Delhi Calm by Vishwajyoti Ghosh, the visual language of narrating the unpropitious is explored in Indian graphic narrative, as well as how traditional means of interpreting Indian identity are displaced by such issues.

Keywords: Indian graphic novel, Visuality, Indianness, Indian society, Post-millennial issues

INTRODUCTION

Since their onset in the Indian market, graphic narratives in both content and form are proving to be insignificant and have rigorously challenged the notion of Indian identity. 'River of Stories' which was published in 1994 by Orijit Sen is generally considered as the first published graphic novel in India which addresses the contentious Narmada Dam project's environmental, socio-economic, and political concerns. Within Western cultures, the graphic storytelling method is commonly recognized as one that tells a complex narrative using dark and unpleasant imagery.As Geeta Menon put it, "India witnessed a belated growth in comic strips. 'Comic' being a western concept, Indians borrowed it from the American and western newspapers" (204).Beginning in the late 1960s, things began to shift as AnantPai, a dreamer with a publishing experience, came up to make history in the world of children's publications by adapting the graphics format to Indian mythology. With the finest Amar Chitra Katha series, he had

a significant effect on young imaginations. Nonetheless, in India, where the graphics have historically exhibited and depicted India in good and 'appropriate' ways, the Indian graphic narrative of the post-millennial era (and graphic novels in general) has provided a task to local readers of India, with less desired representations of Indian identity. The post-millennial Indian graphic novels have little similarity to the Amar Chitra Katha collection of comics, which was a prominent twentieth-century mainstay in India. However, there is a link between the graphic narrative's tangible output and the appeal to 'see' concepts of Indian identity. However, in the post-millennial years, India's perception and definition of graphic narratives and comics production have shifted dramatically. This study argues that, since the millennium, Indian graphic narratives have been problematizing hitherto safe, fixed concepts and projections of the society of India, identity, and history, through Banerjee's re-working of history, portrayals of female violence in Zubaan's curated book Drawing the Line, depiction of sexual preferences in Kari by Patil, episode of 'Emergency' in Delhi Calm by Ghosh, Kokaachi's muted graphic novel rape (HUSH), portrayals of the Kashmir disputes, the re-telling of JotibaPhule's life in A Gardener in the Wasteland or Bheem Rao Ambedkar's life story in Bhimayana, and Banerjee's critical study of modern (urban) society through The Harappa Files and Corridor. These artworks collectively deal with controversial, challenging, and topical subjects in different ways. These 'inconvenient' renderings of India (and Indian traditions in general) contrast sharply with the Amar Chitra Katha legacy, as well as the way India is being visually represented in the public sphere after Independence.

The Main Findings and Results

The Photo

Drawing the Line: Indian Women Fight Back contains 14 vivid short tales, including Reshu Singh's "The Photo." This anthology of short graphic narratives is part of what has been described as an "upsurge in feminist visual art" (Singh, 2015) following the 'Nirbhaya' case in Delhi, December 2012. The graphic short tales in Drawing the Line responses to the encounter with a focus on experiences of females living in metropolitan cities; thus, the visual and textual interpretations in Drawing the Line centers its focus on the working place, public transportation, female activism, domestic violence, and (debatable) ideas of marriage and beauty. 'The Photo' employs a variety of layouts and space. Some sections of the narrative are depicted as pages of full-length artwork confined and contained by the paper's borders, while others are told and visualized utilizing panels spanning 12 pages (A4 format). These panels coexist with artistic elements that aren't enclosed by any paneling; as a result, several of the pages combine multiple layouts and approaches to present both picture and text. A free illustration is employed on a few occasions, and the pictures are produced in a more artistic approach. As observed throughout the poem, the typography is stereotypically cursive and 'feminine. The whole story is depicted in monochrome, using grey, black, and white tones. The story starts with the protagonist Bena with a statement: 'my family can't wait to marry me off [to a stranger] and party wild during my wedding' (Singh, 2015). Bena is the central character of this short graphic story and is having her picture taken at a photo studio. The photograph is taken will be used to seek Bena a husband, making it a crucial part of the 'getting married' stage. As the narrative progresses, we find that Bena comes from a mother-father-sister household and that her parents are pressuring her to marry.

Bena declares to the readers that 'I don't want to get married, simple as that' (Singh, 2015). Bena is afraid of being reduced even more since she feels that she is being reduced to 'a photo'. The duties of the home and her family appear to have worn Bena's mother down physically and emotionally. Close-ups of her face reveal signs of exhaustion, as does one scene in which she complains about knee pain (figure.1). Bena's mother joins her on the couch in this scene, which takes place in the middle of the narrative. 'Oh God, my knees,' as she bends to sit on the couch, her mother mumbles (text here is presented light in font and is not contained by a speech bubble). Bena asks, "What happened?" only for her mother to respond, "Nothing," and swiftly shift the subject. Bena is wearing traditional Indian attire (white salwar kameez) in this scene and we recognize this as being comparable to the white salwar kameez seen in Bena's portrait on the front page. Bena's mother parted her hair from the middle, just like Bena in the picture studio, but she wears bangles rather than a watch on her wrist. As the reader deduces, Bena sits to the right of her mother which indicates that the page differs from the girl on the front cover, whom we assume is Bena based on the textual content. Bena has tied her hair back into a ponytail and is dressed in a T-shirt with flying

birds on it as she sits on the sofa. The combination of the two images—the first is Bena in the picture studio and the second is in front of the readers-resonates with Bena's muddled (and, by extension, ambiguous) personality and relationship with her mother, as well as her decision to marry. The young girl on the sofa is in contradiction with Bena's 'picture,' which is essentially a portrait on one hand and a constructed image of individuality on the other. The didactic language that surrounds the two ladies emphasizes their mother-daughter bond, as well as the prospect of Bena's prospective identity shifting into one she observes in her mother's present situation (as Bena sits comfortably crosslegged on the sofa while her mother complains about her aching knees). The achromatic color scheme, which runs all across the short graphic narrative, is especially jarring here since it reflects the two women's contrasting opinions. The grey colorway represents the space where the position of both of them is challenged as well as bargained as they converse, each expressing a perspective on being (or not being) married. In Figure.1, the two females are represented in close quarters, with this point of view brings to light various details: The bangles and bindi worn by Bena's mother, both symbols of marital status, are conspicuous, but Bena's side-swept hair, black spectacles, and crosslegged position wearing T-shirt and tights imply a young individuality. Bena's T-shirt has birds on it, which add movement to an otherwise static environment. In a panel at the bottom of the page, the two women are back on the sofa, but this time it appears that they have exchanged their personalities as well as their places on the sofa. Bena who earlier can be recognized by her trendy ponytail and cool spectacles now wearing her mother's attire (dress and bangles) and sitting on the left, while her mother is sitting on the right wearing Bena's clothes. With the combination of Bena's personality on the front page and the picture of Bena on the following pages, we see a confluence of identities of both the characters here, with each lady having a visual representation of the other (glasses, bangles, clothes). This visual portrayal leads to the conclusion that neither woman has a single feminine identity; rather, they are both each other and themselves at the same time. A black panel with a white text reads: 'And their own fear' (Singh, 2015)while the two ladies across the sofa staring at each other, each portrayed in sections of the other. The brief graphic narrative concludes with a recursion, bringing us back to Bena in the picture studio (figure. 2).

After exploring the concept of a complex person established via culture, (modern) society, and clan, the tale focuses on the futile attempt to capture 'the self' in one photograph. On the cover page, the word 'The Photo' is put on a black backdrop, but the powerful black contouring, as well as the motif of her spectacles and T-shirt, make Bena's face stand out against a white sky. In this image, she is raised aloft, looking out and above what lays beneath her. 'But I am more than my photo,'(Singh, 2015)says a hefty black thinking bubble written in cursive, white writing. Underneath this paragraph, we see an open diary, which appears to be Bena's and contains bookmarks indicating the pages. The picture taken at the studio is in the middle of the diary's double-page. This image has been substantially altered by scribbling on it with a black marker. The black shell of a black pen rests next to the journal, catching the interest of the observer. Another tiny text box to the right of the pen completes Bena's words typed above. 'Far more,'(Singh, 2015)it says. We recognize Bena's doodling on the photo as her creativity, and we interpret the freshly produced picture as an amplification of her claims that she is so much more than her photograph. She seeks to express her true identity via her own hands by physically altering the photo. Radhakrishnan notes how modern Indian women live in a zone that is midway between the society in which Bena's mother appears to have spent years and the world in which Bena also belongs, or at least desires to belong. Radhakrishnan writes: Those who reject the conventional notion of a respectable woman's place as being in the home reject it explicitly, though they cannot ignore its potential influence on their choices. Most women inhabit an ambiguous space between a new, reshaped notion of respectable femininity that includes home and a 'safe' job that is still entrenched in global networks, and an older vision of idealized feminine domesticity. (157) As Thapan writes, '[l]est the trendy and socially elite lifestyles associated with contemporary consumerism suggest the emergence of amoral or decadent choices, it becomes essential to project the Indian woman as the symbol of all that is good and yet "modern" in the national imaginary'. (416) Bena's decision to use doodle to build a layered personality challenges not just the concept of using a photo to meet a prospective lifemate but also indicates the layering of the unseen. The drawings depict both contentious and inconceivable scenarios. Such a photograph would deter all possible suitors and, moreover, would tarnish Bena's reputation. In post-millennial India, Reshu Singh's short graphic novel tackles relevant, ever-evolving concerns about choice, marriage, sexuality, and partnership. 'The Photo,' with its achromatic color palette,

clearly asks questions about marriage choices, but the grey of the short graphic narrative enables for such inquiry into female's 'self' and identity in the post-millennial time, as well as how millennial ideals of the Indian woman socio-cultural experiences are and should be carried through. Despite the lack of a clear conclusion to the 'marriage question,' the graphic narrative, at least for Bena, closes in a decided textually and graphically. She enacts her agency in shaping who she is, whom she will become, and how she will be viewed by placing her stamp physically on 'the photo.'

Delhi Calm: The Emergency Years

The graphic novel, which was published in 2010 by HarperCollins India, emendates and so narrates the Emergency episode in India. On the construct of history, Ricca writes, "There are many ways to read comics through the arc of history. One is the approach of putting comics into historical context or understanding them in terms of the socio-cultural circumstances in which they were created." The graphic book has a proclivity for reimagining such a past, one rife with personal and societal suffering, according to Nayar:

It hopes to show how politics, critique, reform, or satire now has a new language available to the Indian author: the image-text of the graphic narrative. The graphic narrative, with its verbal-visual and critical literacy, is a medium India needs to address contemporary concerns and provide a politically edged cultural critique. (8)

By virtue of its storytelling style, Delhi Calm offers 'another way of looking' (Pinto) while effectively presenting different ways of 'seeing the Emergency episode. The graphic narrative uses a restricted choice of dark sepia color tones, with black lettering on a white backdrop. The grey, black, and white tones encapsulate, to some extent, how Emergency was witnessed: a terrible moment in India's history that the government would like its countrymen to forget. This creates a contradiction: if something must be forgotten, it must also be remembered. The actions of remembering and forgetting are linked with language and a visual portrayal of the past through the graphic media, which employs both word and picture. In addition, the dark colors evoke a feeling of historical documentation, a re-reading and re-imagining of original material from the archive.The use of a distinct color wash technique, done in grey or dark colors, which provides a backdrop for the text and artwork is a key aspect of this graphic novel. This component is notable not just because it emerges throughout the graphic novel, but also is reminiscent of whitewashing as a method—subtle shading occupies a large space with paint—and, by augmentation, whitewashing as a method of concealing undesirable or (presumed) inconvenient truths about a predicament or an individual. There is a good illustration of both technique and semiotics on page 114: here in fig.3 Indira Gandhi is represented as 'Mother Moon' on a 'much higher' podium, a link to the former page, when Indira Gandhi is indicted on double grounds, using a relatively high podium for her speeches is one of them. Mother Moon is giving her speech from a relatively high podium (see Fig. 3), and Mother Moon's desire to be seen (and heard) while exposing her contempt for the law is emphasized by Ghosh's graph of length, which suggests that the podium is far higher than the last one. The moon theme is both ubiquitous and feminine is effective in Delhi Calm for its ideas of monitoring and a skewed sense of regulation coupled with motherhood love.

Nayar writes,

In its uncovering of historical wrongs, social inequalities, the silence of the victims and the follies of the age, the graphic narrative- engendered critical literacy alerts us to the need for human rights, the historical abuse of certain social groups and the urgent need for reforms. (p. 9)

President of India announced a proclamation declaring an emergency in the country on June 25, 1975. Delhi Calm (Figure. 4) features this date in the center of page 119 which is filled with unfamiliar faces arranged neatly in rows, suggestive of passport images whose primary aim is to identify. The chain from which this foreboding date hangs is shown by a clenched, shackled fist lifted high in protest. Police, someone, you, Mother Moon, persons, and yourself are examples of pronouns or terms connected to people or individuals that emerge in photographs. We hear that MISA has resulted in arrests. MISA (Maintenance of Internal Security Act) is a 1971 legislation that gave federal authorities more power was altered and subsequently abolished when the general election of 1977 was lost by Indira

Gandhi. MISA was renamed by Ghosh as 'Mother Moon's Insecurity Act,' implying that MISA changes were intended to silence protest during the years of Emergency. The State is represented in the speech balloons with statements that may easily be made by Mother Moon supporters: 'Watch out, you're being watched.'; 'Behave yourself, you could be next' (Ghosh, 119). To be clear, the reader is unable to determine how these remarks are intended to be taken due to the mix of visual and textual language. Are we being alerted to the presence of cops on the street? Are we being intimidated and instructed to behave because we 'could be next'? Are we being warned about being monitored so perhaps we will speak quietly or hide our activities, or is that intimidation once more? The fact that these words originate from a group of ordinary individuals, who are aesthetically depicted as diverse but uninteresting in any manner, adds to the overall frightening impression.

Returning to the fist raised, we observe it has ventured to expose fully, breaking free to one of the little panels that would normally be seen to portray 'human face.' Even though this fist, arm, and hand belong to someone, the State's megaphone obscures their identification, i.e. their face. We look at around megaphone at a place where a person's head should be with a shout-out that says, 'The President has proclaimed Emergency.' There is nothing to panic about (page 119). Only after viewing the other elements of this page does the irony of this call-out become complete. The speech balloons above the megaphone state emphatically, and succinctly, that there is reason to be concerned. Furthermore, the irony is encapsulated by two words (Panic and Emergency) that appear so close enough despite the fact that there is an Emergency and we are told that there is nothing to panic about. By being on the opposite side of page 118 in terms of position and mood, the rebellious spirit of page 119 is clearly established. Mother Moon and her opinions on 'democracy' are centered on page 118, which is set to a light-grey wash. Her campaign posters swing above her as her followers emerge alongside; flowers pots decorate the area and the 'stars' glimmer in the sky.

The more complex image on page 119 contrasts with the fairly static, drab, flat image on page 118. The sepia tone's diverse colors provide richness to the illustrations, particularly the date, the arm, and the megaphone, which all acquire on their own perspective. On the next page (page 119), this aspiration is visualized to some extent, just for the concept of rebellion to be crushed by accusations (or warnings) arising from the persons who feature herein. Vishwajyoti Ghosh is a well-known artist and his work Delhi Calm has influenced the development of graphic tales by contributing to the worldwide 'graphic novel movement' (Gravett) of the twenty-first century. Color experimentation, the inventive use of 'signage,' and the portrayal of Indira Gandhi as Mother Moon, among other approaches, not only establish a distinctive 'Ghosh style,' but also highlight how historical events can be told along with an Indian perspective. It is important to emphasize the possibility of an Indian way of 'seeing' its own past because re-imagining and recounting remains a central element in many European graphic novels. As a result, Delhi Calm brings a graphic book style to the table, which Pinto characterizes as "another way of looking; with a "fine disregard"' (Pinto).

CONCLUSION

This article suggests that Indian historical graphic storytelling with its own voice is steadily building a tangible position for itself in the worldwide field of graphic narratives. They go against the traditional concept of showing Indianness in a positive and festive light, using brilliant colors, clear, bold lines, and rich, frequently patterned detail. The characters and narratives evoke a visual inauspiciousness through the use of sketch-like imagery, sharp line drawings, muted colors, hazy and unclear figures, monochromatic colorways, and collage-like methods to storying. Indeed, Indian graphic storytelling foreshadows a dark and foreboding future by invoking the inauspicious. The graphic narratives examined in this paper employ a wide range of visual and linguistic strategies to analyze disputed societal problems such as a woman's decision to marry (or not) and how shared reminiscence evoke recent events, including the Emergency episode and pre-liberalization years. The use of greyscale and color wash technique in Delhi Calm (2010), cursive font, and achromatic colors in The Photo (2015), these visual discourses interact with their reader/viewer through the narratives (visual/textual) of the adverse, and by doing so expropriate established modes of seeing (and thus realizing) Indianness.

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Figure 1. Bena and her Mother (The Photo)

Figure 2. Final page of 'The Photo'

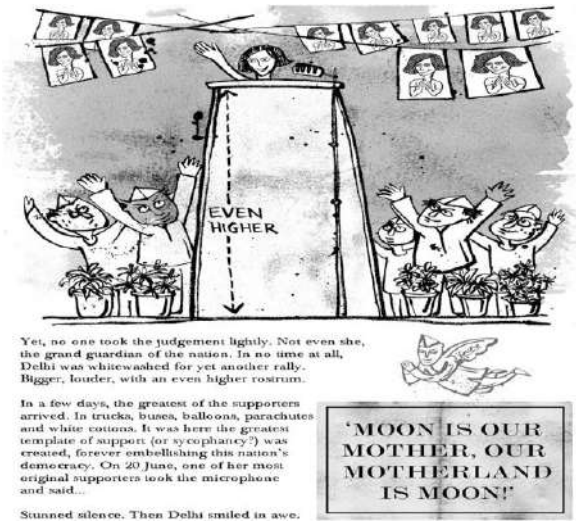

Figure 3. Delhi Calm (Page 114)

Figure 4 Delhi Calm (Page 119)

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RESEARCH ARTICLE

Effect of Organic Inputs on the Growth and Yield of Baby Corn (*Zea mays* L.)

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ABSTRACT

Babycorn is the ear of maize (*Zea mays* L.) plant harvested young only immature cob is harvested as the economic produce within 50 – 55 days. Thus in the areas adjoining cities or other urban areas multiple crops can be raised which would fetch greater income to the farmers. Babycorn can be effectively used as both nutritious vegetable and as an export crop to earn valuable foreign exchange. The present investigation was carried out in the Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai nagar. A field trial was conducted in a Randomized Block Design with nine treatments in three replications. The treatments consisted of two organic manures (enriched farmyard manure and vermicompost), along with four organic foliar nutrients (panchagavya @ 3%, sea weed extract @ 3% humic acid @ 0.2 % and effective micro organism 1: 1000 dilution) were sprayed at fortnight intervals. The results of the study revealed that soil application of vermin compost 5 t ha^{-1} + foliar application of panchagavya @ 3 per cent at fortnight intervals resulted in improving the growth characters *viz*., plant height, number of leaves, leaf length, Leaf width and Leaf area and maximize the yield and yield attributes *viz*., number of cobs $plant^{-1}$, length of cob , girth of cob , individual cob weight and cob yield $plant^{-1}$ of baby corn.

Keywords: Baby corn, Enriched farmyard manure, Vermicompost, Panchagavya, Sea weed extract, Humic acid and Effective Micro Organism(EMO)

INTRODUCTION

Babycorn (*Zea mays* L.) is young corn and rich in nutrients especially in phosphorus content (86 mg 100 g^{-1} edible portion) in comparison to other vegetables (21 to 57 mg 100 g^{-1}), attractive low calorie vegetable having high fibber content with cholesterol (Rai *et al.,* 2004). Besides nutritive value, as it is harvested within 5 to 7 days of tassel emergence and the young cob is wrapped up tightly with husk and protected from chemicals. It is sweet flavour and crisp nature contributes to its increasing attractiveness making it an indispensable ingredient in many fancy dishes today. With the increasing concern for health, people have turned towards quality food in place of bulky items. Babycorn has main place as a safe and quality vegetable. Babycorn by products such as tassel, young stalk and green fodder provide delicious feed for cattle (Vimalendran and Wahab 2014). Babycorn requires a regulated and assured supply of nutrients throughout its growing right from seedling stage to maturity stage. In the present day alarming situation of soil degradation and declining crop yields, sustainability in agriculture with respect to maintenance of soil fertility and stabilized crop production year after year is the main concern. Ever increasing cost of energy would be an important constraint for increased use of chemical fertilizers in achieving production targets coupled with its deleterious effects on soil environment. In fact, there must be a balance between soil degradation and restorative processes that determine sustainability. Sustainable agricultural practices are those, in which the benefits of soil restorative measures are equal to or greater than the overall negative effects of soil degradative processes. An important soil restorative management practice is the use of organic manures for crop production (Chaudhary *et al*. 2004).

Foliar application will be more efficient than soil application at the late growth stage when there is preferential assimilates translocation into seeds/fruits and root activity for nutrient uptake is limited. At the late growth stage, the quality of fodder or human food products can be specifically improved by foliar fertilization. The current global scenario unwaveringly underlines the demand to take up eco-friendly cultivation practices for sustainable food production. The monetary value of inorganic fertilizers is heightening hugely to the degree, so that they are not affordable for small and marginal farmers. (Vimalendran and Wahab.2013). In the light of the above, the present investigation was carried out to study the influence of organic manures viz., enriched farmyard manure, vermicompost, panchakavya, humic acid, Sea weed extract and effective micro organism on the growth and yield of babycorn.

MATERIALS AND METHODS

The present investigation was carried out in the Department of Horticulture, Faculty of Agriculture, Annamalai University. A field trial was conducted in a Randomized Block Design with nine treatments in three replications. The treatments consisted of two organic manures (enriched farmyard manure and vermicompost), along with four organic foliar nutrients (panchagavya @ 3%, sea weed extract @ 3% humic acid @ 0.2 % and effective micro organism 1: 1000 dilution) were sprayed at fortnight intervals. The treatments comprised of two organic nutrients *viz.,* enriched farmyard manure and vermicompost which were incorporated in the soil at the time of last ploughing as per the treatments and four organic foliar nutrients *viz.,*panchagavya @ 3percent,Humic acid @ 0.2 per cent, Sea weed extract @ 3 per cent and effective microorganism (1:1000 dilution) .There were applied in three sprays at fortnight intervals. The half dose of N and full dose of P and K recommended dose of fertilizer were applied at the time of field preparation and the remaining half dose of N was top dressed at 15 DAS. As per the treatment schedule, NPK were given in the form of Urea, Single Super Phosphate and Murriate of Potash respectively. The observation on growth parameters like plant height, number of leaves $plant^{-1}$, leaf length, Leaf width and Leaf area and yield attributes *viz.,* number of cobs $plant^{-1}$, cob length , cob girth, individual cob weight and cob yield $plant^{-1}$. The observations were recorded on 30 and 60 days after sowing and and the data were analysed statistically (Panse and Sukhatme, 1985).

RESULTS AND DISCUSSION

The data presented in Table 1 revealed that all growth parameters were significantly influenced by the application of organic manure and various bio-stimulants, the treatment T_4 (vermicompost 5 t ha^{-1} + Panchagavya 3 % foliar spray at fortnight intervals) which recorded the maximum growth parameters *viz.,* plant height, number of leaves $plant^{-1}$, leaf length, Leaf width, Leaf area (39.43 and 160.66 cm ; 7.41 and 14.52; 36.01 and 79.18 cm; 4.85 and 8.45 cm; 137.71and 597.67 cm^2 respectively) on 30 and 60 days after sowing respectively. Which were closely followed by treatment T_1 (Recommended dose of fertilizers) and recorded the value of 39.08 and 159.11 cm; 7.32 and 14.45 ; 35.94 and 78.91 cm; 4.80 cm and 8.30 cm; 132.89 and 589.21cm^2 respectively, the least growth parameters of 34.84 cm and 126.90 cm; 5.91 and 12.58; 28.83 and 66.45 cm; 3.68 and 6.11 cm; 78.95 and 352.27 cm^2 respectively were registered in treatment T_3 (Enriched Farm Yard Manure 750 kg ha^{-1} + humic acid 0.2% spray at fortnight intervals). Among the treatments, T_4 was lied on par with T_1 and T_6 while, T_8 and T_2 ; T_5 and T_7 ;T_9 and T_3 were found to be on par with each other. The increase in growth parameters due to application of vermicompost may be due to the presence of growth substances, nitrogen fixers, other essential nutrients and also due to higher P fertilization by a symbiotic mycorrhizal association as reported by Kale *et al*. (1987). Incorporation of vermicompost promotes the lush growth of plants which may be due to the presence of plant growth promoters like auxins and cytokinins, which are responsible for the cell division and cell elongation. Organic wastes can be broken down and fragmented rapidly by earthworm, resulting in a stable non-toxic material with appropriative structure which has potentially high value as a soil conditioner for plant growth (Hala *et al*. 2003). Furthermore, Chaudhary *et al.* (2004) also reported that vermicompost contains biologically active substances such as plant growth regulators which enhances sufficient quantity of nutrient flow in the plant system, thereby, increasing the plant height, number of leaves and leaf area. Several investigators mentioned similar results on different plants such as, Bairwa *et al*. (2009) in okra and Saraswathy and Prabhakaran (2014)in tomato.

Panchakavya is a fermented organic manure in which the presence of growth regulatory substances such as IAA, GA and cytokinin, essential plant macro and macro nutrients, naturally occurring, beneficial, effective microorganisms (EMO) predominantly lactic acid bacteria, yeast, actinomycetes, photosynthetic bacteria and certain fungi has been confirmed by Somasundaram (2003). Further, they also suggested that beneficial and proven biofertilizers such as azotobacter, azospirillum and phosphobacteria and plant protection substances like Pseudomonas and saphropytic yeasts detected in panchakavya can be attributed to its efficacy as organic foliar nutrient that might have in turn, stimulated the growth, resulting in increased plant height, number of leaves and leaf area. The beneficial effect of panchakavya on the morphological attributes was also reported by Vimalendran *et al*. (2013) in babycorn and Ali *et al*. (2011) in chilli. The results pertaining to the effect of organic inputs on the yield and yield attributes furnished in Table 2 revealed that significant variations existed among the various treatments. The treatment T_4 (Vermicompost 5 t ha^{-1} + Panchakavya 3 per cent foliar spray at fortnight intervals) recorded the maximum number of cobs $plant^{-1}$ (3.43), the maximum length of cob (11.88 cm), the maximum Cob girth (7.94 cm), The maximum individual cob weight of 25.72 g, the highest cob yield $plant^{-1}$ (88.22 g) , cob yield $plot^{-1}$ (3.71 kg) and cob yield ha^{-1} (7.85 t) respectively. The next best treatment was T_1 (100 per cent Recommended dose of fertilizers) which registered the values of 3.39; 11.84cm; 7.83cm; 25.38g; 86.04g; 3.61 kg and 7.65 t. respectively. The treatment T_4 lied on par with T_1 and T_6 while, T_8 and T_2 ; T_5 and T_7 ;T_9 and T_3 were found to be on par with each other.

The least yield and yield attributes were registered in T_3 (Enriched Farm Yard Manure 750 kg ha^{-1} + humic acid 0.2% spray at fortnight intervals) with the values of 2.03; 8.61 cm;5.38 cm; 17.33 g; 35.18 g; 1.48 kg and 3.13 t. respectively. Yield is a complex character which is influenced by the interaction of many factors and the ultimate goal of any scientific crop production is to achieve the highest possible yield. It was observed in the present investigation that application of vermicompost 5 t ha^{-1} + panchakavya 3 per cent proved to be the best treatment in enhancing the production of more cobs $plant^{-1}$, maximum cob length, cob girth and cob yield. This might be due to the fact that vermicompost provided better nutrition as it contains all major nutrients besides micro-nutrients, it also has some beneficial micro-organisms which results into improved chemical, physical and biological properties of soil. Moreover increased nutrient availability from

the organic manures might have increased various endogenous hormonal levels in the plant tissue, which might be responsible for enhanced pollen germination and pollen tube growth, which ultimately increased the cob production resulting in higher yield as suggested by Vimalendran and Wahab (2013) in babycorn. This is in agreement with the findings of Kaur *et al*.(2015) in various vegetable crops and Gopinathan and Prakash (2014) in tomato. Furthermore, foliar spray of panchakavya facilitates greater uptake of nutrients and increased synthesis of cytokinin and auxin in the root tissue by their enhanced activity due to the application of panchakavya and their simultaneous transport to the axillary buds would have resulted in a better mobilization of assimilates from the source to the sink at a faster rate which in turn, would have helped in the early transformation from the vegetative phase to reproductive phase. The induction of cob formation might have been influenced by the triggering of such metabolic processes and narrowing of carbon: nitrogen ratio by the significant accumulation of carbohydrates, which leads to the enhanced vegetative growth coupled with adequate reserve food material promotes the maximum number of cobs per plant.The results of the present study are in accordance with the findings of Vimalendran and Wahab (2013) in baby corn.

CONCLUSION

Based on the findings of the present study, it is concluded that combined application of vermicompost 5 t ha^{-1} + foliar application of Panchakavya @ 3 per cent at fortnight intervals has beneficial effect on the growth and yield of baby corn (*Zea mays* L.)"

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Table 1. Effect of bio-stimulants on growth characters of babycorn (*Zea mays* L.)

Treatment	Plant Height		Number of leaves		Leaf length		Leaf width		Leaf area	
	30 DAS (cm)	60 DAS (cm)	30 DAS	60 DAS	30 DAS (cm)	60 DAS (cm)	30 DAS (cm)	60 DAS (cm)	30 DAS (cm^2)	60 DAS (cm^2)
T_1- Control (100%RDF)	39.08	159.11	7.32	14.45	35.94	78.91	4.80	8.30	132.89	589.21
T_2- Vermicompost 5t /ha + humic acid 0.2% spray	37.50	146.01	6.45	13.71	33.46	74.44	4.41	7.57	112.05	512.10
T_3- Enriched Farm Yard Manure 750kg/ha + humic acid 0.2% spray	34.84	126.9	5.19	12.58	28.83	66.45	3.68	6.11	78.95	352.27
T_4- Vermicompost 5t /ha + panchakavya 3% spray	39.43	160.66	7.41	14.52	36.01	79.18	4.85	8.45	137.71	597.67
T_5- Enriched Farm Yard Manure 750kg/ha + panchakavya 3% spray	36.43	138.42	5.99	13.33	31.39	70.31	4.18	6.93	101.21	439.28
T_6- Vermicompost 5t /ha + Sea Weed Extract 3% spray	38.81	157.74	7.19	14.33	35.82	78.57	4.71	8.19	128.72	578.23
T_7- Enriched Farm Yard Manure 750kg/ha + Sea Weed Extract 3% spray	36.06	137.11	5.94	13.23	31.29	70.00	4.11	6.80	96.82	429.76
T_8-Vermicompost5t /ha + effective micro-organism (1:1000dilution) spray	37.82	147.62	6.66	13.88	33.63	74.85	4.44	7.76	116.0	525.05
T_9- Enriched Farm Yard Manure 750kg/ha + effective micro-organism (1:1000dilution) spray	35.14	128.36	5.36	12.72	28.97	66.82	3.79	6.28	82.47	364.39
SED	0.27	2.03	0.16	0.14	0.63	1.09	0.09	0.17	3.42	6.84
CD (P = 0.05)	0.58	4.05	0.32	0.26	1.24	2.19	0.19	0.33	6.85	13.67

Table 2. Effect of bio-stimulants on yield and yield attributes of babycorn (*Zea mays* L.)

Treatment	Number of cobs per plant	Cob length (cm)	Cob girth (cm)	Individual cob Weight (g)	Cob yield per plant (g)	Cob yield per plot (kg)	Estimated cob yield ($t.ha^{-1}$)
T_1- Control (100%RDF)	3.39	11.84	7.83	25.38	86.04	3.61	7.65
T_2- Vermicompost 5t /ha + humic acid 0.2% spray	2.82	10.73	7.02	22.79	64.27	2.70	5.71
T_3- Enriched Farm Yard Manure 750kg/ha + humic acid 0.2% spray	2.03	8.61	5.38	17.33	35.18	1.48	3.13
T_4- Vermicompost 5t /ha + panchakavya 3% spray	3.43	11.88	7.94	25.72	88.22	3.71	7.85
T_5- Enriched Farm Yard Manure 750kg/ha + panchakavya 3% spray	2.56	9.90	6.34	20.23	51.79	2.18	4.60
T_6- Vermicompost 5t /ha + Sea Weed Extract 3% spray	3.28	11.71	7.66	25.15	82.49	3.46	7.33
T_7- Enriched Farm Yard Manure 750kg/ha + Sea Weed Extract 3% spray	2.43	9.74	6.14	19.98	48.55	2.04	4.31
T_8- Vermicompost5t /ha + effective micro-organism (1:1000dilution) spray	2.89	10.79	7.09	23.11	66.79	2.81	5.94
T_9- Enriched Farm Yard Manure 750kg/ha + effective micro-organism (1:1000dilution) spray	2.12	8.70	5.52	17.61	37.33	1.57	3.32
SED	0.09	0.24	0.17	0.72	3.64	0.13	
CD (P = 0.05)	0.19	0.48	0.34	1.43	7.25	0.24	

REVIEW ARTICLE

Medicinal Plants from the Punjab Region as an Alternative Treatment for Candidiasis

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ABSTRACT

Fungal infections are the major concern in public health nowadays due to the rise of organ transplantation therapies, cancer, and the spread of covid-19. The major agents, responsible to cause fungal infections involved *Candida albicans*, *C.tropicalis*, and *C.parasilosis, C.galbarta, C.kefyr*,*C. famata, C. krusei*.According to CDC, this increases the mortality rate by upto 25% worldwide and the available treatments for these infections are not effective due to various factors which develop the need for alternative treatments. This article mainly focuses on the medicinal plants from the Punjab region that possess anticandidal activity as Punjab lies in the northern part of India which is considered to have a rich variety of medicinal plants**.**

Keywords: Medicinal plants, *Candida* infection,Punjab, immunocompromised patients

INTRODUCTION

Medicinal plants are known to contain bioactive substances that can be used for the treatment of various diseases and the development of new medicines[1]. Medicinal plants are the backbone of traditional medicine. People are aware of the benefits and usage of medicinal plants since ancient times. Many shreds of evidence are available on the use of medicinal plants by Indian Vaids, Unani Hakims, and European culture for the treatment of many health problems. It has been recorded that China and India have the highest number of medicinal plants followed by Columbia, South Africa, and The United States[2]. India contains almost 17000 species of higher plants among that 7500 plant species are considered to have medicinal properties. In India, the northern part is known to contain a rich variety of medicinal plants because of the Himalayan range[3]. The Punjab region comes in the northern part of India and lies on the foot of the Himalayas. Moreover, the rivers present in the Punjab region of India make the soil more fertile for the growth of natural flora which ultimately provides a wide variety of medicinal plants. According to WHO, about 80% of the world's population is dependant on medicinal plants for health care.The use of medicinal plants has boomed due to the poverty, high cost of modern therapies, less availability of new treatments in rural

areas, side effects of chemicals, and drug resistance to microorganisms. It has been studied that 25% of new medicines are produced by the use of medicinal plants. The growing demand for herbal products causes an increase in the production and trading of plant-based products for the various purpose [4].Medicinal plants and their metabolites are effective against various microbial infections. It has been recorded that flavonoids, sponins, and alkaloids isolated from *Psoraleacorylifolia,* and*Sansevieriagana* plants found in Phagwara, Punjab show antibacterial activity against *E. coli* [5]. Medicinal plants are believed to contain antimicrobial activity against a variety of microorganisms and used their bioactive compounds to treat a variety of infections caused by bacteria. Similarly, *Candidiasis* is an opportunistic fungal infection caused by *Candida spp*. which mainly targets the immunocompromised people. The synonyms for *candidiasis* include *candidosis*, *moniliasis*, and thrush. *Candida species* have been linked with humans as harmless commensals for a long time. They can be found on the mucus membranes of the genitourinary tract and gastrointestinal tract, as well as on human skin. In immunologically weak and immunocompromised people, however, they become opportunistic pathogens.They are responsible to cause mucosal and systemic infections inpatients that have weakened immune system and can migrate to other organs and eventually colonize them[6].Mucosal infections are of two types. Nongenital and genitourinary diseases.The nongenitalinfections usually affect the mucosae of the gastrointestinal,esophageal, and oralpharygeal tracts of immunocompromised patients. In females, the genitourinary infections cause vulvogenital candidiasis whereas in males, balanopothitis, and balanitis. Moreover, it causes Candiuriain both male and female patients[7]. The systemic infection can be fatal as the *Candida* migrates in the bloodstream causes candidemia and infects other organs like heart valves, eyes, spleen, nervous system, and liver[8].The *Candida albicans* are mostly responsible for causing mucosal and bloodstream infection which later develops into disseminated candidiasis and targets other parts. The *Candida spp.*majorly target the patients having weak immune system due to various factors such as organ transplantation, HIV, COVID-19, Cancer, use of immunosuppressive drugs, and a long stay in ICUs. Apart from *Candia albicans,* there are other species such as *Candida tropicalis, Candida galbarta, Candida krusie, Candida famata*, C*andida kefyr*, and *Candida dubliniensis* which are also responsible to cause a similar type of infection[9][10].

Spread of candidiasis in immunocompromised people

***Candida* infection in Covid-19 patients**

As per the records there were 14% cases of candidiasis in covid-19 patients and the cases of Candidemia in patients attacked by COVID-19 were 3-8 fold higher than in non-covid-19 patients. The use ofantibiotics has been seen to be associated with the risk of candidedmia. These antibiotic agents develop conditions like neutropenia as a result of this patients are being attacked by *Candida* Species such as *C.albicans and C. galbarta*[12].

***Candida* infection in cancer patients**

It has been studied that chemotherapy treatments in cancer patients target the rapidly dividing cells of the immune system which are responsible to stimulate an immune response against a variety of antigens. Due to this, Hematopoietic stem cells get damaged as a result of this no new source for the generation of new cells is remained alive. Due to this, the patients are attacked by opportunistic pathogens *like Candida, Aspergillus crypotoccocus*. It has been noted that patients having solid organ tumors are more likely to develop *Candida* infections as compared to blood cancer patients[13].

***Candida* infection and organ transplantation**

The *Candida* pathogen has a significant chance of infecting solid organ transplant recipients. This can cause invasive candidiasis due to excessive colonization. The colonization level increases due to the use of broad-spectrum antibiotics. It has been recorded that iron overload also increases the risk of invasive candidiasis. Hence in liver transplantpatients, the presence of iron content in hepatocytes can result in post-transplantation candidiasis. In the case of renal transplantation, *Candida* can infect the urinary tract, and kidneys and can result in organ failure. In most cases, *Candida* infects the blood and develops the condition of candidemia which can infect other organs[14].

The mortality rate due to *Candida* infection

The candidemia is responsible to damage the organs of the immunocompromised people. When the *Candida* invades the bloodstream and colonizes the organs of the whole body. This condition is known as septic shock caused by candidemia. A study was performed on 216 patients suffering from septic shock by candidemia. It was recorded that 116/216 died[15].Another study on candidemia mortality rate was conducted in the Tertiary Care Hospital of North India, it was noted that 168/233 died due to candidemia in 2001-2004 whereas in 2005 20/44 died[16]. It has been studied that candidemia is responsible for causing less than 50% of deaths in developed countries and more than 50% of deaths in developing countries[17].

Prevalence of *Candida* infection

In 2009, a study on Reproductive tract infections was conducted in the four villages in Punjab, India. During this study, vaginal swabs, urethral swabs, and blood and urine samples were collected from 400 individuals(200 males and 200 females). Out of 400, 47 individuals tested positive for RTI. It has been calculated that the prevalence of RTI/STI in females was 40/200 and in males 7/200. The 8/200 females tested positive for vulvovaginal candidiasis[18].Another study was conducted from 1st October 2007 to 1st October 2012 in Christian Medical College & Hospital of Ludhiana,there were almost 5724 samples of sputum, pus, bile, bronchoalveolar lavage, nasal swab collected in the lab which included the study of fungal pathogens. Out of which 689 samples were tested positive for fungal infections. Of these 689 samples, 520/689 samples were confirmed positive for *Candida* infections,followed by 110/689 *Aspergillus* infections, 34/689*Mucor*, and 9/689 *Cryptococcus* infections(Table 1). It has been studied that more than 200 species of *Candida* were involved to causes *Candida* infection in the patients[19].

Another study was performed in 2009 in Dayanand Medical College and Hospital, Ludhiana. Here the samples were taken from 110 patients who were admitted to the medical and surgical department. It has been recorded that 91/110 samples were *Candida* positive and 3 cases of *Aspergillus* and 1 case of cryptoccocal infection were reported[20].In 2013, a short survey on nosocomical *Candida* infections was conducted in rural territory care hospital, Amritsar, Punjab. The samples were collected from different departments and accounted for 1200. Out of these 1200 samples, 52 samples were *Candida* positive. The maximum number of cases were from ICU(17/52) and surgical departments(13/52) which was followed by the department of Medicine (10/52), Department of gynecology (9/52), and department of paediatrics(2/52) and Department of orthopaedics (1/52). The 24/52 cases were of *Candida albicans* followed by 28/52 were positive for *C. galbrata, C.kefyr, C. parasilosis, C. krusei, C. tropicalis, and Candida dublieniensis*[21].The study conducted by the Dept. of Microbiology,Sri Guru Ram Das Insititute of Medical Science and Research in 2016-2017 showed a higher number of non-albicans infections than *C. albicans*. There was a total of 56 cases of *Candida* infection Out of 56, the 16 isolates were of *C. Albicans* and 40 isolates were of non-Albicans strains [22].The study was conducted on fungal infection in the Respiratory tract in the Dept. of Microbiology, Govt. Medical College Amritsar from May 2018- to June 2019. According to this study, 241 sputum samples were collected from adult patients. Out of 241 samples, 158 samples were positive for fungal infections. The 66/158 samples were tested positive for *Candida albicans* and 33 samples were tested positive for non-albicans infection(Table 2)[23].

Need for alternative Treatments

There are many synthetic drugs that are used for the treatment of candidiasis. However, due to the resistance shown by *Candida spp*.(Table 3) against the available antifungal agents develop the need for the discovery of alternative treatment. Moreover, the available drugs are fungistatic and have high toxicity which ultimately is responsible to cause side effects to the patients. The immediate side effect of the use of Amphotericin B includes fever, rigors, headache, nausea, hypotension, weight loss, vomiting, and hypokalemia. The long-term use of Amphotericin B is responsible to cause renal failure. The use of flucytosin is responsible to cause drug-dependent leukopenia, enterocolitis, hepatitis, and rash. The azoles used in the treatment of candidiasis are highly metabolic unstable. Another necessity to discover alternative treatments is the expense of these drug therapies[24]. Moreover, a search on PUBMED with keywords 'human antifungal plants in Punjab, India' was performed. The results showed only 15 references from 2005 to 2022 which indicates very less research has been done on plants for the treatment of fungal infections(fig 1).

Diversity of plants in Punjab (India)

Punjab is a state which lies in the north of India and is surrounded by Himachal Pradesh to the East, Pakistan to the West, Haryana to the south, Kashmir to the north, and Rajasthan to the southwest. Chandigarh is the capital of Punjab and Haryana. Punjab has a total area of 50,766 square kilometers. 84% of the area is used for agricultural purposes. The Punjab region has three major biogeographic zones that include central alluvial plains, northeastern Shivalik foothills, and southwestern dry zones. The Shivalik foothills are the major forest area in Punjab and it comes in the district of Gurdaspur, Ropar, and Hoshiarpur. Hence major cultivation of flora and fauna is seen in the Shivalik region. It has a wide variety of Angiosperms that include 755 types of herbs, 70 types of shrubs, 61 types of twines, 70 types of trees, 19 types of vines, and 71 varieties of pteridophytes, and 67 varieties of bryophytes. A wide variety of gymnosperms can also be seen in this region. Therefore, the Shivalik region is also known as the zone of micro-endemic of India. Himalaya is a rich zone for medicinal plants but as Punjab lies in the foothills of the Himalayas, hence a wide variety of medicinal plants are found in the Punjab region which can be used for the treatment variety of fungal infections(Table 4), (Table5)[29].

CONCLUSION

The fungal species infect the patients with a weak immune system and show resistance to the available drugs used for the treatment. This creates the need for the development of alternative antifungal agents that can be the source of new medicines. It has been studied that medicinal plants produce an abundance of secondary metabolites such as flavonoids, terpenes, alkaloids, and many other bioactive compounds which contain antimicrobial properties. It has been studied that these medicinal plants are cost-effective for the individual and lack side effects, unlike synthetic drugs. Hence many industries are also practicing new techniques to use the bioactive compounds in the development of health care products. These medicinal plants with such properties may also be used to treat deadlyfungal infections. As most medicinal plants are found in the northern part of India. Therefore we targeted the Punjab region and listed the plants found in the Punjab region that contain antifungal activity against *Candida* species.

Future perspective

This study will help researchers gather the information about the extract of these plants and help to find out the active component of these plants which has anticandidal activity, on the basis that new drugs can be designed to target *Candida* infections in humans without causing any side effects.

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Table 1: The annual increase in the cases of fungal infections:

Fungal agent	2007	2008	2009	2010	2011	2012
Candida sp.	24	91	112	101	128	64
Aspergillus sp.	4	16	30	25	20	15
Cryptococcus	0	0	2	2	4	1

Table 2: Cases of infection by *Candida spp*

Fungal species	Number of cases
C.glaberata	3
C. krusei	4
C.paraspilosis	6
C. tropicalis	18
C. albicans	66

Table 3: *Candida* resistance to available drugs

Drugs	Mechanism action	Mechanism of resistance
Amphotericin B	It binds to the Ergosterolpresent in the plasma membrane and causes the formation of pores which causes the leakage of potassium and magnesium ions and causes the disruption of cells.	The absence of Ergosterol in the membrane of fungal cells and the difference in the structure of target sterol prevents the binding of amphotericin B with Ergosterol. In some cases, a mutationin the biosynthetic pathway of Ergosterol causes the synthesis of other sterols which shows poor affinity with Amphotericin B.[25]
Azoles	Azole prevents the biosynthesis of Errgosterolas it acts as an inhibitor of cytochrome P450 14a-sterol demethylase.	EGR11 encodes for lanosterol C14 alpha demethylase enzyme that is responsible for the synthesis of Ergosterol. Mutation in EGR11gene rellucts the azole to bind to its target site. In some *Candida* strains, the EGR11 gene is overexpressed. Thus, strains show resistance to azole drugs. Excessive exposure to azole drugs results in the depletion of ergosterol in the membrane and causes the accumulation of 14 alpha-methyl 3-6 diol. However, the mutation in the ERG3 gene prevents the conversion of 14 alpha methylfacosterol to 14alpha methyl 3-6 diol. Thus the presence of 14 alpha methylfacosterol is not affected

		by azoles and shows resistance to azole and amphotericin B [26].
Echinocandins	It is responsible to inhibit the activity of 1,3 Beta-glucansynthase that aids to support the fungal cell wall	Mutations that occur due to amino acid substitutions in the FKS gene encode for beta 1-3 D glucancan cause resistance.
5-flucytosine	It acts as a nucleotide analog and requires to get activated by the proteins of the FUR1 and FCY1 genes to show antifungal effects.	Mutation in the FUR1, FCY1, and FCY2 genes results in flucytosine resistance.[27][28].

Table 4: Antifungal plants found in the Punjab region(30)

Sr.no.	Plants	Region	Active against	Reference
1	*Allium sativum*	Punjab	*C. albicans*	(31)
2.	*Aloe barbadensis*	Punjab	*C. albicans*	(32)(33)
3.	*Brassica Nigra*	Punjab	*Candida albicans*	(34)
4	*Bauhinia variegata*	Punjab	*C. albicans*	(35)
5.	*Cannabis sativa*	Punjab	*C. albicans*	(36)
6.	*CarumCarvi*	Punjab	*C. Albicans*	(37)
7.	*Dolichos lablab*	All over India	*C. albicans*	(38)
8.	*Euphorbia hirta*	Hot regions of Punjab	*C. albicans*	(39)
9.	*Foeniculumvulgare*	Punjab	*Candida albicans*	(40)
10.	*Habisicus.sabdariffa*	Punjab	*Candida albicans*	(41)
11.	*Litseaglutinosa*	Punjab	*C. albicans*	(42)
12.	*Mangiferaindica*	Punjab	*Candida albicans, A. fumigatus, A. flavus, A. niger*	(43)
13.	*Menthapiperata*	Punjab	*C.albicans, C. galbarta, C. tropicalis*	(44)
14.	*Murrayakoenigii*	North India	*Candida albicans*	(45)
15.	*Pimpinellaanisum*	Punjab	*C. Albicans,C. parapsilosis, C. galbarta,C. tropicalis, C.krusei*	(46)
16.	*Plumbagozeylanic*	Punjab	*C. Albicans*	(47)
17.	*Psoraleacorylifolia*	Punjab	*C. Albicans*	(48)
18.	*Puerariatuberosa*	Punjab	*C. albicans*	(49)(50)(51)
19.	*Sphaeranthusindicus*	Punjab	*C. Albicans*	(52)
20.	*Catharanthusroesus*	Punjab	*C. albicans and C.krusei*	(53)
21.	*Withaniacoagulans*	Drier parts of Punjab	*Candida albicans*	(54)

a

b

c

d

e **f** **g** **h**

Table 5. Medicinal plants having anticandidal activity. (a) ***Catharanthusroseus, (b) Carumcarvi, (c) Mangiferaindica, (d) MenthaPiperatta, (e) Brassica Nigra, (f) Murrayakoenigii, (g) Cannabis Sativa, (h)Aloe barbadensis.*** **The following pictures of plants are taken from Jalandhar region of Punjab.**

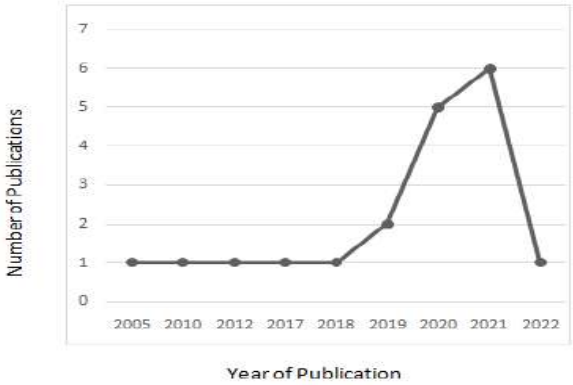

Fig 1. PubMed search with keywords human antifungal plants in Punjab India. There is a total of 15 references from 2005 to 2022. The X-axis denotes the number of articles and Y-axis denotes the year of publication.

RESEARCH ARTICLE

Extent of Adoption Level of Fertilizers Schedule by Different categories of Sugarcane Cultivators in Cuddalore District

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ABSTRACT

The key to agricultural development lies in the minds, hearts and hands of the farmers. It is a motivated technology which must release the lock and open the door to modernize agricultural industry. In the field of agriculture alone, farmers in most of the developing countries do not keep pace with the fast growing up technology. So there is an increasing gap between innovations in the laboratories and their adoption at the field level. Adoption of technology is a complex pattern of mental and physical activity. Several personal psychological, economic and recommended technology social factors largely determine the extent and nature of adoption of and also the continuance of technology. So for this efficiency, lack of proper and timely training for extension personal was also attributed as one of the foremost resources. The present study was carried out in selected six villages from six blocks of Cuddalore district of Tamil Nadu. The respondent compressing of marginal, small and big sugarcane growers numbering 240 respondents were selected by using proportionate random sampling method. Data collection was done through a well constructed and pre-tested interview schedule. The collected data were tabulated and analysed by using appropriate statistical tools. The recommended dose of fertilizer was adopted by most (85.00 per cent) of the respondents irrespective categories. Among the categories all the big (100.00 per cent) farmers adopted the recommended phosphatic fertilizer, followed by small (88.75 per cent) and marginal (66.25percent) famers. Most (85.83 per cent) of the respondents had applied the recommended dose of nitrogenous fertilizer in proper time. All the big farmers adopted the of recommended dose of nitrogenous fertilizer followed by small (83.74 per cent) and marginal (73.75 per cent) farmers. Application of recommended dose of potash was adopted by almost all (95.41 per cent) the respondents irrespective of the categories, whereas, among the big farmers, the respondents with higher educational status, extension agency contact, who made joint consultative decisions possessed higher mass media exposure and information source classification were found to possess high rate of adoption. In case of

marginal farmers, extent of adoption was comparatively lesser than small and big farmers, which might be because of the small sized land holding and poor economic status.

Keywords: Data collection , big farmers, nitrogenous fertilizer, phosphatic.

INTRODUCTION

The key to agricultural development lies in the mind, heart and hands of the farmers. Communication of agricultural information was inefficient and ineffective leading to an increase in the gap between innovations in the lab and the adoption in the fields by the farmers. It is the motivated technologies which must release the lock and open the door to modernization of agricultural industry. the single force which accelerates this process is the effective dissemination of the adequate agricultural information to the farmers. In the field of agriculture alone, farmers in most of the developing countries do not keep pace with the fast developing technology. So there is an increasing gap between innovations in the laboratories and their adoption in the field. The adoption of technology is a complex pattern of mental and physical activities. Several personal, psychological, economic and social factors largely determine the extent and nature of adoption and also continuance of the technology. so for this inefficiency, lack of proper and timely training for extension personnel was also attributed as one of the foremost reason.

Review of Liturature

Review of literature is an important step in any research pursuit. A good understanding of the problem requires an analysis if the existing body of knowledge in the area of research under question. This chapter is devoted to retrospective analysis of the available literature , which are directly or indirectly related to the study. The literature collected in the light of the objective are presented. Pandhare et al., (2003) that half the proportion (58.67 per cent) of the farmers had medium level of adoption, whereas one -fourth (25.33 per cent) of the respondents possessed high level of adoption. Only 16.00 per cent of respondents had low level of adoption. High number of the farmers adopted recommended variety of sugarcane (96.67 per cent), preparatory tillage (88.67 per cent), right harvesting time (80.00 per cent), selection of season (74.67 per cent), improved implements (58.67 per cent), second earthing up (56.00 per cent), was method of planting (53.34 per cent) and irrigation schedule(52.00 per cent). Less than half the proportion of the farmers adopted improved cultivation practices like timely first earthing up (47.00 per cent), set treatment with hot water (33.34 per cent) and use of Bavistin or Azatobactor (33.34 per cent), intercropping (6.47 per cent), crop protection measures (6.67 per cent), micro-nutrients (5.34 per cent) and mulching operations (5.34 per cent). Poswal et al., (2005) reported that 41. 36 per cent of the respondents had low level of adoption followed by 34.09 per cent with medium and 24.55 per cent with high levels of adoption of sugarcane practices. They reported that more than sixty per cent cane growers do not adopt the scientific crop production technology properly due to non-availability of resources. The overall adoption level was observed to be 39.47 per cent, 50.36 per cent and 58.83 per cent among marginal, small and big farmers respectively. The average adoption level was found to be 46.45 per cent in all categories of sugarcane farmers.

RESEARCH METHODOLOGY

The study was carried out in selected six villages from six blocks of Cuddalore district. A total number of ten sugarcane technologies with technological units were for the study. the respondents were pre-stratified into marginal, small an big farmers consisting of eighty respondents in each category. altogether, Two hundred and fourty respondents were selected from six villages using proportionate random sampling. Data collection was done though a well constructed and pre-tested interview schedule. the collected data were tabulated and analysed by appropriate statistical tests.

FINDINGS AND DISCUSSION

In this present study, extent of adoption was operationalised as the actual level of use of technological units of each of the selected sugarcane cultivation practices by the respondents. in this section, the data on extent of adoption of sugarcane cultivation have been presented in Table 1. From the data given in the Table 1, it could be inferred that more than one-third of the respondents were found under low (35.83 Per cent) and medium (35.00 per cent) categories of adoption. The remaining 29.17 per cent of the respondents were found to be high in their extent of adoption. Hence it may be concluded that most of the cultivators felt under low to medium category in their extent of adoption of sugarcane technologies. The calculated chi-square value indicated that there was significant difference between the different categories of farmers regarding their extent of adoption. In case of marginal and small farmers, the level of adoption was comparatively less than the big farmers. Larger farm size of big farmers might have enhanced them to increase the number of farm activities, which in turn would have led to higher adoption, whereas this could not be possible in the case of marginal and small farmers. Similar finding was reported by Poswal et al, (2005). Hence the null hypothesis (3,4,4), which states that there will be no difference between the different categories of sugarcane cultivation regarding their extent of adoption is rejected.

CONCLUSION

The recommended dose of fertilizer was adopted by most (85.00 per cent) of the respondents irrespective categories. Among the categories all the big (100.00 per cent) farmers adopted the recommended phosphatic fertilizer, followed by small (88.75percent) and marginal (66.25percent) famers Most (85.83 per cent) of the respondents had applied the recommended dose of nitrogenous fertilizer in proper time. All the big farmers adopted the of recommended dose of nitrogenous fertilizer followed by small (83.74 per cent) and marginal (73.75 per cent) farmers. Application of recommended dose of potash was adopted by almost all (95.41 per cent) the respondents irrespective of the categories, whereas, among the big farmers, the respondents with higher educational status, extension agency contact, who made joint consultative decisions possessed higher mass media exposure and information source classification were found to possess high rate of adoption. In case of marginal farmers, extent of adoption was comparatively lesser than small and big farmers, which might be because of the small sized land holding and poor economic status.

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Table. 1. Extent of Adoption Level of Fertilizers Schedule by Different categories of Sugarcane Cultivators

Sl . NO.	Extent of Adoption	Marginal farmers (n=80)		Small farmers (n=80)		Big farmers (n=80)		Total (n=240)		Chi-square value
		No.	%	No.	%	No.	%	No.	%	
1.	Low	36	45.00	29	36.25	21	26.25	86	35.83	54.13**
2.	Medium	34	42.50	38	47.50	12	15.00	84	35.00	
3.	High	10	12.50	13	16.25	47	58.75	70	29.17	
Total		80	100.00	80	100.00	80	100.00	80	100.00	

** - Significant at 1% level

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RESEARCH ARTICLE

User perception and Professional Awareness on Learning Management System among Science and Social Science Higher Education Teachers

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ABSTRACT

An online integrated programme called a learning management system (LMS) is used for developing, delivering, monitoring, and reporting educational courses and outcomes. It can be applied to traditional face-to-face training, blended/hybrid learning environments, and online learning environments. (bie,2022).User perception and professional awareness on learning management system emanates as an important aspect in knowing the general perception of higher education teachers with regard to the use of technology and awareness on its intricate aspects. This perception often would lead to new evolving technologies for the future generation of learners to nurture upon. The present paper elaborates on the use of LMS usage and finds out the perception on LMS usage based on gender and subject among higher education teachers. The statistical results show that there is no significant difference in the usage of LMS with regard to Gender specificity. The difference in usage is found with respect to subject demarcated as science and social science. The usage of LMS will become multitude in the coming days as the post pandemic (COVID) generation of teachers and students have been triggered towards the use of technology in the teaching learning process.

Keywords: LMS, Professional Awareness, Higher Education Teachers, COVID

INTRODUCTION

Modern learners' demands are continually changing, and as a result, the old classroom-based approach is quickly losing its relevance and becoming less effective. Additionally, schools, colleges, and institutions are moving away from the four walls of their classrooms and are utilising the digital environment as a result of the growth of online learning during the COVID-19 epidemic. According to a recent report, by 2025, educational institutions will spend up to $350 billion on instructional technology. This includes applications such as virtual tutoring, video conferencing, and, most significantly, learning management systems (LMS). In situation like COVID, learning management systems provide educational institutions with a clever alternative and enable instructors to give

personalized information, make use of different pedagogical methods, and engage their students much better than was previously feasible. In fact, a survey found that the education sector accounts for one out of every five LMS installs, which is a stunning ratio. Through software and programme created especially for student learning, LMSs establish a standard connection between the students or learners and the learning contents. According to Sutherland et al. (2004), by documenting the activities on the computers and displaying statistics and plans, they manage learning events, materials, and learners as well as administer and control the learning processes and the performance of the learners.

Learning Management systems

An online integrated programme called a learning management system (LMS) is used for developing, delivering, monitoring, and reporting educational courses and outcomes. It can be applied to traditional face-to-face training, blended/hybrid learning environments, and online learning environments. (bie,2022). An LMS is a piece of software that controls how online courses and training programme are managed, monitored, and reported inside an organization. It serves as a virtual classroom where instructors can interact with their pupils and carry out online learning activities. higher learning LMSs serve as online classrooms. Students can study and learn from the convenience of their homes, whatever the distance. Callan, , Margaret and Alison (2015) Similar to this, educators might keep giving lectures and instructing the next generation. It provides them with the adaptability and accessibility they require to keep their daily lives feeling regular. Due to education through LMS, students do not have to be deprived in advancement of their academic careers by a year. They would only need a device and internet access to go back to school. Students and lecturers will no longer be constrained by physical distance or location. It allows instructors and students to share instructional materials, makeclass announcements, submit and return course assignments, and communicate with each other online. .Learning management systems have been used to manage online classes, monitor student involvement, create learning materials, make announcements in class, provide content to students, and track success. In actuality, teachers' and students' use of digital learning and e-learning determines its effectiveness, which in turn depends on teachers' user perception and professional LMS comprehension. Knowing the teachers' perspectives and professional grasp of the LMS is therefore crucial.

Background of study

A thorough investigation of 55 school districts in New York State was reported (Mann and Shafer,1997). Data from 4,401 teachers, 1,722 students, 159 principals, and 41 superintendents were collected and analysed. The dependent variable was performance on a exam at the undergrad level, and the independent variable was instructional technology use. The introduction of technology could account for 42% of the difference in math results and 12% of the variation in English scores. Sixth-grade math was where elementary children made the biggest improvements. Higher results on the state's comprehensive evaluation and more use of technology were strongly correlated. There was no control group, and the study was not experimental. Additionally, there were no evaluations of students' performance prior to their introduction to computers. However, every piece of information (quantitative, qualitative, longitudinal, and anecdotal accounts) led to the same conclusion: more technology promotes student progress. It was also discovered that technology at elementary and middle schools had a higher impact in smaller schools and that teachers' initiative and passion were directly tied to the technology's success. Schlago-Schirm (1995) discovered significant gains on the New Jersey Early Warning Test from the pre-test to the post-test when CAI was the intervention in a study of ninth grade students. However, no research was done to evaluate if ordinary classroom education would be a more or less successful intervention. According to Becker (1992), Individual learning systems seem to be most effective for children who fall on either the high or poor achievement spectrum. Students in the middle of the class distribution seem to be significantly less likely to receive assistance from them. This leads to a somewhat positive rating for overall efficacy. Positive effects at the lower and upper ends of the distribution are balanced out by the middle group's negative influence. Orabuchi (1992) investigated the impact of CAI on higher-order cognitive abilities throughout the course of a four-month experimental investigation. The study's participants were 70 second graders and 61 first graders. The outcome of a standardised achievement test served as the dependent variable. The efficiency of interactive software programmes in terms of drawing conclusions, making generalisations, and solving mathematical problems was evaluated using Analysis of Variance (ANOVA). The first

grade experimental group greatly outperformed the control group in terms of answering math problems. This suggests the value of early exposure. The statistics showed that all kids' academic performance improved as a result of BS/CE, and the neediest kids gained the most, according to Mann et al. (1999). The greatest improvements were made by children whose homes lacked computers. Additional evidence included the fact that there was no difference in gain scores between white and non-white pupils and that there were no gender inequalities in math and reading. To ascertain the effect of computer use on mathematical achievement, Wenglinsky (1998) conducted a study using data from the 1996 National Assessment of Educational Progress (NAEP) in mathematics. Six different subgroups of students were created, including ones based on economic background, gender, and ethnicity. True access was defined as using the computer on a weekly or more frequent basis. Additionally, computer use was divided into lower-order and higher-order groups. For both fourth graders and eighth graders, drill and practise were viewed as lower-order uses, but learning games, simulations, and applications were seen as higher-order uses. According to Weaver (2000), the National Educational Longitudinal Study monitored a group of 25,000 students who were eighth graders in 1988. This group was examined twice over a two-year period. Cognitive exams were given to the students, and each kid, two of their teachers, one of their parents, and a school administrator received questionnaires. Computer use was evaluated using survey responses on an ordinal scale ranging from one (never) to three (frequently). From the above study it can be found that the studies have found the usage of computer aided instruction and assessment to have propelled in educational scenario.

Objectives

- To find out the utilization of LMS in teaching learning in classrooms
- To analyse significant difference in perception on LMS usage among teachers based on gender
- To analyse significant difference in perception on LMS usage among teachers based on Subject

METHODOLOGY

The Data was collected using a Likert scale five-point questionnaire on User perception and awareness on LMS in Science and social science teachers through Google forms and direct interview. The sample collected includes 148 teachers from higher education institutions concerned with UG PG level teaching. The samples were collected randomly and the sampling technique is stratified random sampling. Percentage analysis and t test were used to analyse the collected data.

Analysis and Interpretation

When the collected data is demarcated based on gender, the data collected consisted of 9.7% male and rest of them were female teachers On question of usage of LMS 79.2% answered yes while the 16.7% have answered in the negative, even though the LMS usage has been a need in the time of the COVID spread some of the teachers have relied to direct live interaction and WhatsApp rather than LMS On the kind of LMS used the use of A tutor and results were least among teachers highest usage was of google meet in the data taken followed by I cloud which are the preferred software's by the university in going forward with teaching learning process. On the usefulness of LMS in the teaching learning process the response showed 58.3% agree with this opinion and 26.4% strongly agree while 15.3% were neutral on the statement. Surprisingly there were no disagreements to the statement which itself proves the LMS to be a reliable source in transacting the curriculum in higher education institutions. On usage of learning management system to accomplish tasks easily. The responses were 69.4% agree, 13.9% strongly agree and 15.3 % were neutral. The general tasks of teaching learning process like continuous assessment through assignments, quizzes, transmitting and sharing notes, power points become easy with LMS while some teachers find difficulty in getting acquainted with the new learning management system at initial stages which may be one of the reason to specify LMS as not satisfying to accomplish task. On people view of LMS usage influence on behaviour in terms for better teacher learning during Pandemic. 50% were neutral, 2.8% strongly agreed and 22.2% agree on such influence. The disagreement was 25% (12.5% strongly & 12.5% Disagree) which shows that LMS cannot control the behaviour of user while the learner is using the LMS. Some learners tend to be off screen during LMS usage and keep mum

during the session with teacher or do not submit assignments on time. The behaviours due to teacher learner being separated in time and space cannot be put under control. On question of university supporting the LMS usage in terms of economics and lending help in learning the LMS agreement was above 60% indicating universities had initiated the learning of LMS by making it part of the curriculum transaction. while if the neutral perception is taken as disagreement and no intention to reveal the reality together crosses beyond 30%. This result suggests that university and teacher involvement together in learning of LMS is congruent at above average level and mostly self-initiated studies were further engorged by university further on in the peak of COVID.

OBJECTIVE 1

The calculated value of C.R. is 1.0468 and is not significant at 0.05 level (C.R. = 1.0468; p>0.05). Two-tailed P value equals 0.2969 this difference is considered to be not statistically significant. Hence the mean of the Male teachers do not differ significantly from that of the Female teachers in the in perception on LMS usage and its effectiveness in teachers based on gender

OBJECTIVE 2

The calculated value of C.R. is 2.0831and is not significant at 0.05 level (C.R. = 2.0831; p>0.05). Two-tailed P value equals 0.0390 this difference is considered to be not statistically significant. Hence the mean of the Science teachers differs significantly from that of the Social science teachers in the perception on LMS usage and its effectiveness in teachers based on Subject

CONCLUSION

From the analysis of data percentage wise on the perception and Professional Awareness on Learning Management System among Science and Social Science Higher Education Teachers it is found that there is a significant difference in the perception of science and social science teachers in the use of LMS as science teachers expressed use of LMs to be effective in transacting the subjects with ease. The LMS usage was accepted widely by both the gender. The COVID pandemic has ushered in the need for learning LMS for interaction and content delivery via the net which is a positive sign in itself for the future.

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Table 1: To analyse significant difference in perception on LMS in teachers based on gender

Gender	Number	Mean	Standard deviation	C.R.	Level of significance
Female teachers	136	24.69	10.58	1.0468	Not significant
Male teachers	12	21.20	7.95		

Table 2: To analyse significant difference in perception on LMS usageamong teachers based on Subject (Science and social science)

Gender	Number	Mean	Standard deviation	C.R.	Level of significance
Science	57	32.58	8.35	2.0831	Significant
Social science	91	27.45	5.65		

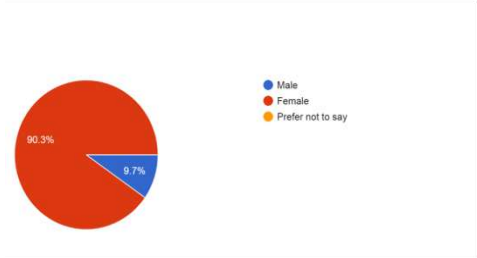

Fig. 1 Demarcation based on gender

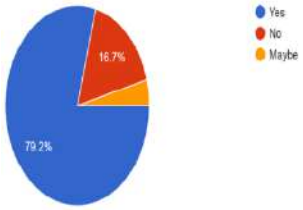

Fig. 2LMS usage during COVID

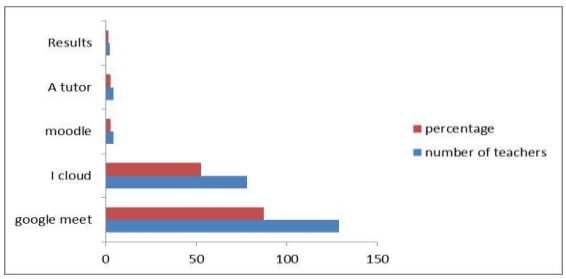

Fig. 3 Usage of type of LMS

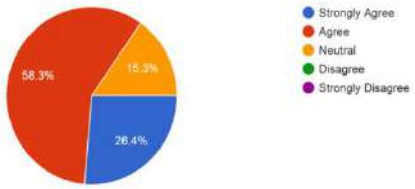

Fig. 4Usefulness of LMS in transacting curriculum

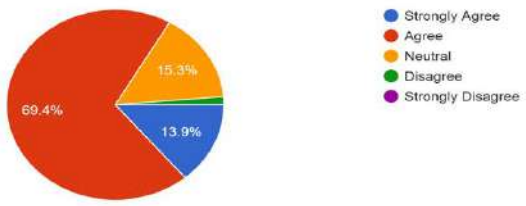

Fig. 5 Usefulness of LMS for CCE

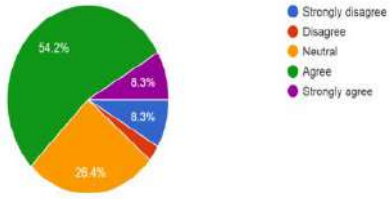

Fig. 6 LMS usage influence on behaviour

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RESEARCH ARTICLE

Impact of Sleeplessness on Stress and Well-Being among Breast Cancer Survivors

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ABSTRACT

Breast cancer is a life threatening disease, contributing to 18 million cases worldwide. Breast cancer survivors frequently face stress, insomnia, and impaired well-being, all of which negatively impact their quality of life. The goal of this study was to ascertain the effect of sleep deprivation on stress and well-being in breast cancer survivors undergoing treatment at a tertiary care hospital in southern India. A cross-sectional descriptive study was done among 150 breast cancer survivors using a purposive sampling technique. The majority of the breast cancer survivors exhibited poor sleep quality (62%), with a higher level of stress (77.33%) and a 66.69% well-being score. There is a moderately positive relationship between sleep and stress, as well as sleep and well-being [(r=0.26 P≤0.05] .It shows that when stress increases, sleep quality decreases, and when sleep is disturbed, well-being is decreased. Nurses should provide appropriate interventions that increase sleep quality, which in turn reduces stress and improves overall well-being. Intensive nurse led counseling and support may aid women with breast cancer in controlling their stress and enhancing their sleep, so improving their quality of life.

Keywords: Breast Cancer Survivors, Perceived Stress, Quality of Sleep, Wellbeing.

INTRODUCTION

Breast cancer is the second most frequent type of cancer, with high mortality rates among women, particularly in developing countries, where the majority of cases are detected late, making it the most lethal disease [1]. By 2020, 2.3 million women were diagnosed with breast cancer, resulting in a global death toll of 6,850,000. In 2020, there had been 7.8 million women alive who have been diagnosed with breast cancer in the last five years, making it the world's most prevalent malignancy. Breast cancer is the leading cause of disability-adjusted life years (DALYs) loss in women [2]. Cancer claimed the lives of approximately 6,00,000 people in the United States between 2007 and 2017. Lung, breast, and colon cancers were the three leading causes of death among women, with breast cancer accounting for 7% of deaths [3]. Breast cancer accounts for 2.1 million cancer cases each year, making it the fifth leading cause of cancer death worldwide [4,5]. Breast cancer is the most prevalent type of cancer in India's north, south, and central regions [6]. Breast cancer is expected to surpass prostate cancer as the most frequent type of cancer in 2025. It accounts for approximately 42.2% of the age-adjusted incidence rates of 28 PBCR under the National Cancer Registry Program [7]. By 2020, it is anticipated that the number of breast cancer cases registered would reach 17,97,900, a relative percentage of 10% [8]. Breast cancer survivors had a 90% five-year survival rate and an 83.3% ten-year survival rate.

As a result of their exhaustion and stress, breast cancer survivors reported various degrees of sleep disturbances [9]. According to long-term breast cancer survivors, 51% had really significant sleep problems [10]. Sleep disturbances have been linked to stress, fatigue, impaired health-related quality of life, and symptoms of cancer [11]. The majority of breast cancer survivors suffer from at least one sleep disturbance, lowering their overall quality of life significantly [12]. Sleep disturbances are reported to be one of the top five most debilitating recurring conditions among breast cancer survivors, with 67–90 % experiencing difficulty sleeping [13,14]. Patients with breast cancer who experience sleep disturbances demonstrate deficits in their ability to perform daily duties. Sleep disturbances may occur at a similar rate in breast cancer patients undergoing and not receiving cancer care, despite the fact that sleep disruptions are caused by a variety of different factors [15].

Recent years have seen a rise in the prevalence of psychiatric illnesses among breast cancer survivors. Breast cancer diagnosis and treatment, both before and after therapy, are well-known to be highly stressful [16]. These difficulties have been extended through the post-treatment phase till complete recovery [17]. These psychological difficulties are associated with women's body image, feminity, sexuality, and parenthood. Additionally, physical changes, disfigurement following treatment, and uncertainty about recurrence all contribute to a period of stress, anxiety, depression, social adjustment, and low self-esteem [18]. Additionally, it is vital to intervene early in the treatment of breast cancer patients and their families in order to improve their quality of life. Inadequate health and management of one's familial, financial, and social life contribute to the stress experienced by women with breast cancer [19]. Women's well-being is defined as the awareness of one's physical, psychological, and social functioning in a good light. Well-being has to be classed as Hedonic or Eudaimonic. Hedonic well-being is subjective, involving a cognitive component associated with an increased sensation of pleasure and decreased discomfort, which results in happiness. Eudaimonic wellbeing can be defined as psychological well-being that incorporates components such as self-actualization, personal expressiveness, and stamina [20].

Nurses are critical in assessing and caring for breast cancer patients over the course of their survival. However, studies on breast cancer patients' perceived needs from a nursing perspective have been underreported in India. The purpose of this study is to determine the effect of sleep deprivation on the stress and well-being of breast cancer survivors.

MATERIALS AND METHODS

Study design and setting

This is a quantitative descriptive cross-sectional study conducted in the Tamil Nadu Government Multi Speciality Hospital in Chennai, India, in the Medical Oncology Department.

Ethical approval

The Institutional Review Board of TNGMSSH, Chennai accepted the protocol for this study under reference number 1577/P&D I/TNGMSSH/2017/BMS/003/07/2020.Additionally, the study was registered with the Clinical Trials Registry of India with the number CTRI/2020/08/027291.

Sample criteria

Permission was acquired in advance from the competent authority to perform the study. Participants were informed about the study in their native language, and consent was gained orally and in writing. Data on sociodemographic and clinical variables were collected using a validated questionnaire. To determine each participant's eligibility, they were screened in advance. Purposive sampling method were used to collect the data from 150 breast cancer survivors. The inclusion criteria were as follows: a) has been diagnosed with breast cancer and has been seeking treatment for at least six months; and b) understands and speaks Tamil. c) attending cancer outpatient and inpatient departments. Breast cancer survivors were excluded based on the following criteria: a) unable to speak in Tamil, b) unwillingness to engage, and c) having co morbidities.

TOOLS OF DATA COLLECTION

Demographic data such as age, weight, residence area, and habits were obtained from subjects, as well as clinical variables such as duration of treatment, stage, and kind of treatment such as chemotherapy, radiation, or surgery. The data were collected using standardised tools such as the Pittsburgh sleep quality index, the Perceived Stress scale, and the Well-being Scale (WeBS).

STATISTICAL ANALYSIS

For data entry, the acquired data was loaded into Microsoft Excel 2010. The Statistical Package for the Social Sciences (SPSS) version 21 was used for statistical analysis. For regularly distributed variables such as age, marital status, income, co morbid conditions, and treatment duration, descriptive statistics (mean and standard deviation) were calculated. For demographic and clinical data, frequencies and percentages were determined. To examine the data, the chi square and Mann Whitney U-test / kurskal Wallis H-test were utilized. Data on stress, sleep, and well-being from a demographic-clinical perspective. The Karl Pearson correlation coefficient was used to examine the correlations between sleep, stress, and well-being status of breast cancer survivors..

RESULTS

The mean age of the participants were 51.5(79.51%), with 85 (56.67%) being overweight and 89 (59.33%) having completed basic school. Around 132 (88%) were married, 119 (79.33%) were married for ten years, and 131 (87.33%) had children. Around 122 (81.35%) of participants were full-time homemakers, 84 (56%) earned between Rs. 5000 and 10,000 per month, 123 (82%) lived in nuclear households, and 50 (33.33%) lived alone or with others. Around 123 (82%) were Hindu, 94 (62.67%) lived in semi-urban settings, and 87 (58%) had no concomitant illness. In terms of clinical characteristics, the majority of 140 patients (93.33%) were diagnosed for five years and survived for at least five years. Around 92 (61.33 %) were diagnosed with stage III breast cancer, 75 (50%) had a right breast tumour, and 96 (64%) were getting hormonal therapy. 138 (92 %) were mostly self-sufficient, whereas 114 (76 %) slept between 4 and 8 hours.

According to the Pittsburgh Sleep Quality Index, 93 (62%) of participants reported having a terrible night's sleep, while 57 (38.00%) reported having a good night's sleep, illustrating how participants were affected by sleepless nights (Table 1). The perceived stress scale score among cancer patients was generally high; none of the patients had a low level of stress, 22.67 % had a moderate level of stress, and 77.33% had a high level of stress (Table 2). Breast cancer survivors had a high level of well-being in 66.69 % of cases, while 33.21 % had a low level of well-being (Table 3).

The domain wise well-being scale score among the breast cancer survivors contributes to the hedonic well-being of [Mean =11.27, SD= 2.63], financial well-being with [Mean =12.91, SD=4.60], social well-being of [Mean =16.49, SD= 2.94], physical well-being of [Mean =21.99, SD=5.01], and eudaimonic well-being of [Mean =26.93, SD= 5.38] which is significantly high among the participants and respectively. The PSS score and the PSQI score had a positive fair correlation [(r=0.26 P≤0.05)](Figure 1). It indicates when the stress score increases, the sleep disturbance increases in turn. Between the PSQI and the Well-being scores, there was a substantial positive correlation. [(r=0.26; P= 0.05)]. (Figure 2). It indicates that when the sleep disturbance score grows, their overall health score lowers proportionately.

DISCUSSION

The study insisted on the importance of an effective sleep pattern, which has been lacking among its participants having difficulty in falling asleep. Similar studies confirmed the current study's findings that participants' mean sleep quality score was 14.06 ±3.06, [9] majority of them slept less than the recommended 7 hours per night at each assessment (range 57–65 %) [21], 71.9% of women reported having poor sleep quality [22], and 38% of these clients were classified as having a sleep disorder. The variation in sleep quality was greater in a few trials, which could be explained by regional and behavioural differences [23]. Stress plays a specific role in breast cancer survivorship, with a high level of stress among the participants of this study. A recent study discovered a high prevalence of stress among breast cancer survivors and concluded that stress factors contribute significantly to intensifying the disease process and impairing survivors' coping capacities and quality of life [24]. The term "well-being" refers to the holistic health of breast cancer survivors, as evidenced by the participants' average level of happiness. The findings of this study corroborate those of another study in which the well-being status is commonly defined as low and high. The majority of participants (66.67%) reported having a high level of well-being, whereas 33% reported having a low level of well-being [25]. Physical well-being is linked to daily work tasks and family functioning as a result of exercise's beneficial effect on physical health's well-being parameters. The role of sports activities in maintaining physical health in this population must be investigated [26].

Sleep loss has a significant effect on breast cancer survivors' stress levels. These study findings were correlated with another study in which it has been proven that sleep disturbances have a significant effect on stress level, which can be rectified with tailored interventions [27]. The quality of life and well-being of these people is affected due to enormous sleep disturbances due to their treatment and survivorship [28]. Breast cancer survivors experienced high levels of stress, which had a detrimental effect on their health. Appropriate measures are required to effectively manage stress. It is vital to establish nurse-led breast cancer survivorship clinics in both clinical and community settings to address the perceived needs of breast cancer survivors. Sleep deprivation had a greater impact on stress, which had a negative effect on the survivors' well-being. Nurses should provide interventions that increase sleep quality, which in turn reduces stress and improves overall well-being. Intensive nurse counselling and support may assist women with breast cancer in managing stress and improving sleep, in turn improving their quality of life. Future study should evaluate the causal link between stress, sleep quality, and well-being status in women with breast cancer using longitudinal and multidimensional techniques. Additionally, future research should strive to find other variables that influence present outcome variables and to study a larger and more diverse sample to generate more generalizable results. Despite significant limitations, this study evaluated the survival rates of women diagnosed with breast cancer at various stages of the disease.

Author Contributions

All authors has read and authorised this work, and each author has met the authorship requirements. Each contributor believes the document represents honest labour and that the knowledge contained inside is unique.

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Table 1: Level of PSQI score

Level of PSQI score	Number of patients	%
Normal(<5)	57	38.00%
Poor(≥5)	93	62.00%
TOTAL	150	100.00%

Table 2: Level of Perceived Stress Scale Score

Level of score	No. of patients	%
Low	0	0.00%
Moderate	34	22.67%
High	116	77.33%
Total	150	100.00%

Table 3: Level of Well Being Scale (WeBS)

Level of WeBS score	No. of patients	%
<4	50	33.33%
≥4	100	66.67%
Total	150	100.00%

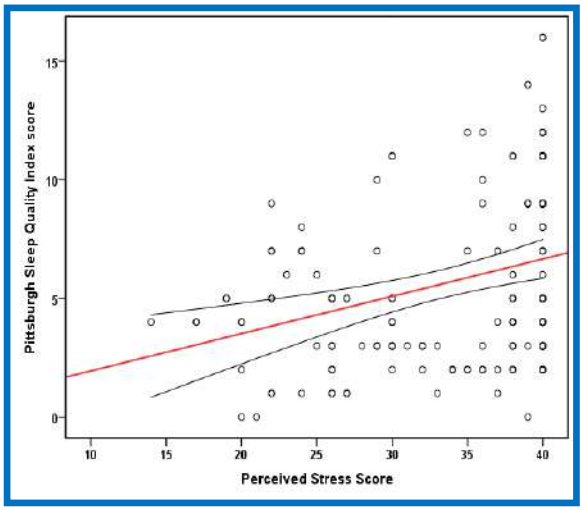

Figure 1: Scatter Diagram with Regression Estimate between PSS Score And PSQI Score Among Breast Cancer Patients

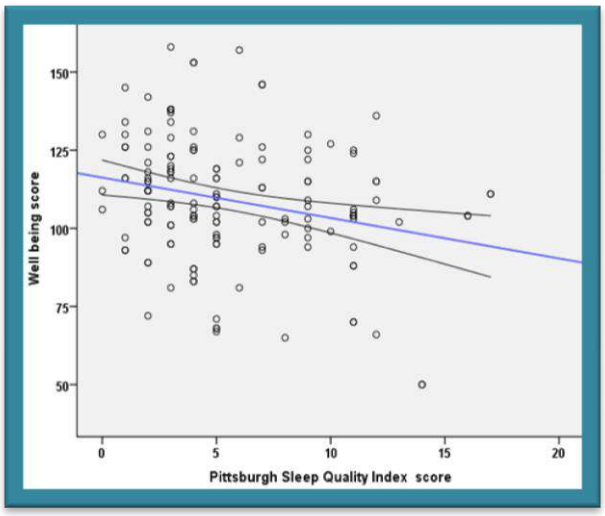

Figure 2: Scatter Diagram with Regression Estimate Between Sleep Disturbance Score and Well - Being Score Among Breast Cancer Patients

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RESEARCH ARTICLE

Effectiveness of Video Assisted Teaching Module Regarding Knowledge on Pranayama among Hypertensive Women at Karaikal

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ABSTRACT

Health and holistic health is directly connected which gives significance to physical, mental, social and spiritual health as whole. Hypertension is directly associated with circulation, respiration and function of vital organs. Complementary therapy like pranayama is directly having effect on mental and physical health. So Pranayama importance on promotion, prevention and curative measures and helps to maintain normal blood pressure. Another therapy is also very much valuable aspect of health care system. To measure the blood pressure of hypertensive women before Pranayama intervention. To find the effectiveness pranayama on blood pressure of hypertensive women after Intervention. This study was adopted pre - experimental research design of pre and post test with quantitative research approach. By using purposive sampling technique selected and 100 hypertensive women were included in this study. The systolic and diastolic blood pressure of the samples was assessed by using digital sphygmomanometer done for the selected hypertensive women .The data was collected in the selected area Kilinjalmedu at Karaikal by using structured questionnaire and to assess the knowledge on pranayama among hypertensive women before implementation of video assisted teaching module. The procedure was explained to them in detail with video assisted teaching module. The time allotted to each hypertensive women 20-30 minutes and post test conducted after one week pre test**.** Present study during pre test 78% had inadequate knowledge, 12% had Moderate knowledge and 10% had adequate knowledge, and during post test 0% had inadequate knowledge, 17% had Moderate knowledge and 83% had adequate knowledge. Therefore this result shows that video assisted teaching module was effective in improving the knowledge regarding Pranayama among hypertensive women. The Mean, Standard deviation and 't' Value regarding the pre test and post test effectiveness of pranayama on hypertensive

women. The obtained post test mean 25.12 (SD = 4.77) was less than the pre test mean 12.25 (SD= 2.91) and the paired' value was 12.995which is significant at p<0.05.It was inferred that post test had significantly reduced after video assisted teaching module regarding among hypertensive women. The findings of present study represented that current intervention Pranayama was effective in reducing the blood pressure level among hypertensive women. Nurses have to highlight and encourage the hypertensive women regarding the practice of pranayama. It can be helpful in relaxing the mind of practitioners in that way making them feels better which in turn may demonstrate to be helpful in reducing blood pressure over a period of time.

Keywords: Effectiveness, knowledge, pranayama, hypertensive women and video assisted teaching module.

INTRODUCTION

In a world of growing technology and machine controlled medical interventions people are beginning to feel the need for a human individual touch for a more natural approach to health that seeks to develop life rather than break down illness into more and more obscure diseases. Favorably there are a number of natural therapies which have just such a positive holistic approach and have also stood the test of time to emerge as the most rational way to sustain our health into the twenty-first century.

Normal blood pressure is 120/80 mm Hg. High blood pressure is defined by a level greater than 130/80 mm Hg or 140/90 mm Hg, according to various guidelines. "It is known as the silent killer. High blood pressure can cause significant damage to the brain, heart, kidneys and blood vessels. Pranayama is "breathe control even though breathing is one of our spontaneous bodily functions. We can also control the breath to some extent. Pranayama significantly reduces the risk of arrhythmia an abnormal heart rhythm that may prevent the heart from pumping adequate blood to the body by changing underlying electrophysiological individuality of heart activity patients with arrhythmia. The pranayama has acknowledged a strong ability for slow breathing practices to have philosophical effects on the autonomic nervous system including the capability of reducing blood pressure even in patients with hypertension.

Health and holistic health is directly connected which gives significance to physical, mental, social and spiritual health as whole. Hypertension is directly connected with circulation, respiration and function of vital organs. Complementary therapy like pranayama is directly having effect on mental and physical health. So Pranayama importance on promotion , prevention and curative measures and helps to maintain normal blood pressure. Alternative therapy is also very much valuable aspect of health care system.

STATEMENT OF THE PROBLEM

A Study to assess the Effectiveness of Video Assisted Teaching Module regarding Knowledge on Pranayama among Hypertensive Women in Kilinjalmedu at Karaikal.

Objectives

- To assess the knowledge on pranayama among hypertensive women before video assisted teaching module.
- To find the effectiveness of video assisted teaching module regarding knowledge on pranayama among hypertensive women after video assisted teaching module.
- To find the association between the posttest knowledge on pranayama with selected demographic variables.

METHODS AND MATERIALS

This study was adopted pre - experimental research design of pre and post test with quantitative research approach. By using purposive sampling technique selected and 100 hypertensive women were included in this study. The systolic and diastolic blood pressure of the samples was assessed by using digital sphygmomanometer done for the selected hypertensive women .The data was collected in the selected area Kilinjalmedu at Karaikal by using structured questionnaire and to assess the knowledge on pranayama among hypertensive women before and after implementation of video assisted teaching module . The procedure was explained to them in detail with video assisted teaching module. The time allotted to each hypertensive women 20-30 minutes. The allotted one week used for completing the pre test. Soon after pre test video assisted teaching module shown to hypertensive women regarding knowledge on pranayama. The time period was 20-30 mts .The post test was conducted one week after pre test by using the same tool, which was used for pre test.

PLAN FOR DATA ANALYSIS

Descriptive statistics such as mean, mean percentage, standard deviation were used to analysis the effectiveness. Inferential statistics such as chi-square was used to associate the knowledge with demographic variables. The hypotheses were set at 0.05 level of significance.

FINDINGS

Section 1: In this section the description of percentage distribution of demographic variables of hypertensive women.

The Demographic information of hypertensive women shows highest percentage of the were in the age group 41- 50 years (45%), According to their occupation shows that private sector (31%) , According to their duration of illness 47% women had more than 5 years , Regarding the educational status of the hypertensive women had graduation(41%) , 62% of hypertensive women had Married, According to their religion 54% were Hindus, 47% of hypertensive women were living in Nuclear family , Highest percentage (64%) of hypertensive women had Non – vegetarian, Belongs in Rural area (55%) and Regarding sources of information (36%) of hypertensive women through family members.

During pre test 78% had inadequate knowledge, 12% had Moderate knowledge and 10% had adequate knowledge, and during post test 0% had inadequate knowledge, 17% had Moderate knowledge and 83% had adequate knowledge. Therefore this result shows that video assisted teaching module was effective in improving the knowledge regarding Pranayama among hypertensive women. The Mean, Standard deviation and 't' Value regarding the pre test and post test effectiveness of pranayama on hypertensive women. The obtained post test mean 25.12 (SD = 4.77) was less than the pre test mean 12.25(SD= 2.91) and the paired' value was 12.995which is significant at $p<0.05$. It was inferred that post test had significantly reduced after video assisted teaching module regarding among hypertensive women.

DISCUSSION

Present study during pre test 78% had inadequate knowledge, 12% had Moderate knowledge and 10% had adequate knowledge, and during post test 0% had inadequate knowledge, 17% had Moderate knowledge and 83% had adequate knowledge. Therefore this result shows that video assisted teaching module was effective in improving the knowledge regarding Pranayama among hypertensive women. The Mean, Standard deviation and 't' Value regarding the pre test and post test effectiveness of pranayama on hypertensive women. The obtained post test mean 25.12 (SD = 4.77) was less than the pre test mean 12.25(SD= 2.91) and the paired' value was 12.995which is significant at $p<0.05$.It was inferred that post test had significantly reduced after video assisted teaching module regarding among hypertensive women. Prof .China Chadayan *et al.,* 2020 Supported in this study the mean score of the

systolic blood pressure turned into 156.45 in pretest and 142 in posttest diastolic blood pressure turned into 96.3 in pretest and 84.6 in posttest. The expected value become 5.78 which is significant at p>0.05. It indicates that pranayama became powerful in reducing the blood pressure levels amongst patient with hypertension. In an experimental study, Yadav RC noticed significant decrease in systolic and diastolic blood pressure, after 12 weeks of practice of Pranayama. Malhotra V *et al.,* We also observed measurable improvement in blood pressure. This finding is similar to previous reports saying that yogic practice has a beneficial role on cardiovascular system. Studies reported that long term as well as short term yogic practice decreased heart rate and blood pressure.

CONCLUSION

The findings of present study represented that current intervention of video assisted teaching module on Pranayama was effective in reducing the blood pressure level among hypertensive women. Nurses have to highlight and encourage the hypertensive women regarding the practice of pranayama. So pranayama can be helpful in relaxing the mind of practitioners in that way making them feel better which in turn may demonstrate to be helpful in reducing blood pressure over a period of time

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Table 1. Pre test and Post test knowledge on pranayama among hypertensive women.

S.NO	Knowledge on Pranayama	Pre test	Post test
1	Inadequate knowledge	78 %	0 %
2	Moderate knowledge	12 %	17 %
3	Adequate knowledge	10 %	83 %

Table 2. Effectiveness of video assisted teaching module regarding pranayama on hypertensive women

Test	Mean	SD	't' Value(p)
Pre test	12.25	2.91	12.995
post test	25.12	4.77	

Table 3. Association between the post test blood pressure of hypertensive women with their selected demographic variables

S.NO	Demographic variables	DF	X2 value	P -value	Significance
1	Age	6	4.312	0.229	Not significant
2	Occupation	8	4.183	0.214	Not significant
3	Duration illness	6	1.987	0.575	Not significant

4	Education	4	9.576	0.023	Significant
5	Marital status	6	1.259	0.573	Not significant
6	Religion	6	5.153	0.076	Not significant
7	Type of family	6	10.256	0.009	Significant
8	Food pattern	2	11.754	0.006	Not significant
9	Area of residency	4	3.458	0.687	Not significant
10	Source of information	6	4.183	0.214	Not significant

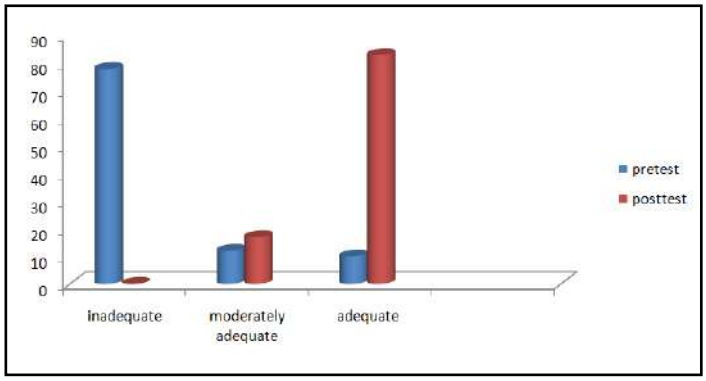

Fig..1 Pre test and Post test knowledge on pranayama among hypertensive women

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RESEARCH ARTICLE

Comparison of Resnet 50 and VGG16 Classifiers for the Detection and Classification of Nutrient Deficiency in Cotton

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ABSTRACT

Symptoms of nutrient deficiencies in cotton plants often appear on the leaves. The leaf color and shape, therefore, can be used to diagnose nutrient deficiencies in cotton. Image classification is an efficient and fast approach for this diagnosis task. Deep Convolutional Neural Networks (DCNNs) have been established as an effective tool in image classification, but their use to identify nutrient deficiencies in crop plants has received little attention. In the present study, we explore the accuracy of two different DCNNs for diagnosis of nutrient deficiencies in cotton. A total of 3000 images of cotton leaves were obtained via sand culture experiments to cover full nutrition and 10 classes of nutrient deficiencies. The images were divided into training, validation, and test sets in a 5: 1: 1 ratio. Fine-tuning was performed to evaluate two state-of-the-art DCNNs namelyVGG16 and, ResNet50.The results demonstrated the great superiority of ResNet50 model in segmentation compared with VGG16. Also, the highest overall classification accuracy of 97% was obtained by the ResNet50 outperforming VGG16 classifier. This study demonstrates that DCNNs provide an effective approach to diagnose nutrient deficiencies in cotton.

Keywords: Cotton, Deep Convolution Neural Network, VGG16,ResNet50,Nutrient deficiency

INTRODUCTION

Cotton is one of the most important fiber and cash crop of India and plays a dominant role in the industrial and agricultural economy of the country. It provides the basic raw material (cotton fibre) to cotton textile industry. Cotton in India provides direct livelihood to 6 million farmers and about 40 -50 million people are employed in

cotton trade and its processing. Manures and fertilizers are essential for ensuring high and stable yields of cotton. The best results come when specific fertilizers are applied in the needed amounts at the proper time. However, cotton is often cultivated without such targeted nutrient input in India. Unscientific fertilization practices are common and, when coupled with a general delay between research findings in cotton nutrition and widespread adoption of technology, which result in imbalanced nutrient application to cotton crops. At present, blanket fertilization is still followed frequently by many cotton growers. As a result, greater amounts of fertilizers are applied to achieve only limited increases in cotton yield, and the quality of the resulting cotton fiber also declines. Without realizing potentially attainable increases in yield and income, small and marginal farmers are getting only small amount as profit due to lack of awareness to properly fertilize the cotton crops in time. Diagnosis of nutrient deficiencies in cotton is an integral part of scientific fertilization, because soils often fail to meet out the nutrient demands of growing cotton plants. Determination of the needed nutrients will facilitate the formulation of a fertilization programme to supply the target nutrients without oversupplying others. Symptoms of a nutrient deficiency in cotton are manifestations of malnutrition in the crop; they can be visually inspected from the plant morphology and thereby provide enough information to diagnose the nutrient deficiency. Problems arise as soils are over exploited, and many nutrient deficiencies are widely distributed both across a farm or region and in time throughout the growing season. It is therefore a challenge for agricultural experts to properly diagnose symptom and effectively correct it in time. In addition to manual diagnosis, chemical and nondestructive analytical methods have been used to identify nutrient deficiencies in crops. Chemical diagnoses can be classified as either full-scale analysis or rapid tissue measurement (Ata-Ul-Karim et al., 2016). Full-scale analysis measures the contents of nutrient elements in a crop. This diagnostic technique can determine all the nutrient elements essential to a plant's survival and those involved in its growth (Xiong et al., 2019). The results are precise and reliable and usually provide sufficient data for diagnosis, but the technique involves vast labour costs and is confined to a laboratory.

The rapid measurement of unassimilated nutrients in plant tissues is carried out by visual colorimetry, which is fast, straightforward, and generally suitable for field diagnosis. Due to the extensive examination required for deeper analysis, this technique is usually applied to assess deficiencies of major elements such as N, P, and K in crops. The minimal contents of trace elements and the high precision required for their analysis prevent rapid measurement of their status. Nondestructive diagnosis techniques include *in situ* measurement using a chlorophyll meter, spectral remote sensing, and computer vision. The first two of these methods are costly or complicated in data processing and are suitable only for specific elements. In contrast, computer vision requires only a smartphone for low-cost image acquisition and transfer, making image-based diagnosis potentially the best and most versatile solution. Conventional computer vision methods such as support vector machines (SVMs) have demonstrated their ability to detect nutrient deficiencies of five elements such as N, P, and K in the leaves of rape (Zhang et al 2018) and rice (Chen et al 2017); yet, SVMs run the risk of over fitting large datasets as they are sensitive to outliers. Convolutional neural networks (CNNs) are attractive machine learning tools (LeCun., 2015), and since the success of deep CNNs (DCNNs) in the Image Net Large Scale Visual Recognition Challenge 2012 (ILSVRC 2012), they have become the preferred choice for image recognition. However, the use of DCNNs to identify nutrient deficiencies in cotton has rarely been reported. Inspired by the Plant Village Project (Hughes and Salathe2015) we explored the accuracy of diagnosing nutrient deficiencies in cotton by processing image data from sand culture experiment, with two different DCNNs as potentially practical solutions for real-time crop assessment.

MATERIALS AND METHODS

Sand culture Experiment

The dataset is the key for fitting a model with good generalization ability. Many studies have utilized the Plant Village dataset, which is based on expert knowledge as some of the observed nutrient deficiency symptoms and diseases can be directly identified by visual cues. Although the symptoms of nutrient deficiencies in cotton are similar universally, a challenge remains in collecting images in the field covering all the deficiency types. Here, we designed a sand culture experiment to collect images for 10 classes of nutrient deficiencies (N, P, K, Ca, Mg, S, Fe,

Mn, Zn, and B, each denoted by a minus sign followed by its chemical symbol, e.g., –N) and contrast them with cotton plants under full nutrition, making a total of 11 classes. The sand culture experiment was conducted with cotton ((*Gossypium hirsutum* L.) var LRA 5166) the major local variety in Cuddalore region of Tamil nadu. We designed the experiment as a single-factor test with three replications. Eleven nutrient solutions (pH 5.0–5.5) were prepared separately. The contents of full-strength Hogland nutrient solution and 10 deficiency solutions are used as treatments in the study. Each treatment was performed in a 10kg plastic pot. Pre cleaned and washed silica sand was filled in the pots. Two seeds were sown in each pot, after germination, one seedling was maintained in each pot, the plants are maintained till the development of deficiency symptoms

Dataset

The symptoms of nutrient deficiencies manifested during the sand culture experiments are recorded using moble camera. The morphological symptoms of cotton plants differed among the 11 classes due to the nutrients having various physiological functions in the plant system. For example, Ca, Mg, Fe, Mn, and Zn are directly or indirectly related to chlorophyll formation and/or photosynthesis, and therefore their deficiencies result in chlorosis. As P is associated with carbohydrate metabolism, its deficiency results in carbohydrate retention in the leaves and thus purple-red coloration developing in the stems and leaves due to the formation of anthocyanins. The symptoms of nutrient deficiencies were also influenced by the mobility of the nutrients in the plant system. Mobile elements such as N, P, K, and Mg, when deficient, tend to move quickly toward the younger parts of the plant, making symptoms always appear first in older parts such as the lower leaves. Conversely, deficiencies of less mobile elements such as Ca and Fe often manifest in the younger parts of the plant. Mobile phones captured images from plants leaves at different time points depending on the location and progress of the symptoms. Before photography, the deficiency symptom must be at least minimally recognizable, and the minimum recognized unit of the symptom was used as the image framing center, the images of cotton leaves included complex backgrounds; they were given one of 11 class labels according to the assigned nutrient deficiency. The images were cropped to ensure that the symptoms appeared prominently and therefore reduce memory usage for better calculation performance. Because the time points of different deficiency symptoms are inconsistent, data collection cannot guarantee the balance of each class throughout the experimental period. The figure 1 shows the proposed architecture diagram. The plant leaf images, both healthy and affected at multiple stages (early and later stages) are acquired through mobile camera. After data collection, the next step is to perform the image augmentation, which include rotation, re-scaling, zooming, horizontal flip, width shift, and height shift. Further, we performed image processing steps renaming and resizing, and new sample images were generated to enrich the dataset. Next, the samples data is labeled with the help of expert knowledge. The labeled sample data is then used during the training phase of the selected deep learning algorithm. Finally, we identify and classify the nutrient deficiency and the results are compared and evaluated to identify the appropriate algorithm for a given situation.

Data Augmentation

Data augmentation is a method of creating new training data from previous training data. We apply domain-specific techniques to samples from the training data to generate unique and distinct training instances. In this research, we augment the images by rescaling, rotating the images, changing the width and height shifts, zooming the images, and doing the horizontal flip. All the images are renamed by python code, resized by the cv2 library, and converted into RGB images for further data processing. The dimensions of the images are (224 x 224 x 3), height and width are 150 and 150, and 3 represents RGB channel (Red, Green, and Blue). During the training and testing phase, the image input size must be the same as the input size applied to the model (Resenet50and VGG16). In this research the image size was adjusted to 224x224 for both the models. Then the pixel value (between 0 and 255) is scaled to the interval [0, 1]. The pixel values are normalized because the deep learning models prefers to handle the smaller input values. Data augmentation is applied during the training process. This operation can be performed using Keras and Image Data Generator functions by applying conversion operations including rotation, width and height shift, scaling and horizontal flip. Amplification is performed on training data, not on data validation.

Performance Considerations

It is common practice to execute image augmentations on-the-fly during the model training and not pre-compute them ahead of time. Since the datasets for computer vision tasks are typically large in size, this allows one to overcome limitations of the storage space without sacrificing the diversity and amount of image transformations. Many computations in modern deep learning models have been moved to be executed on general-purpose consumer-grade parallel computing chips, such as graphics processing units (GPUs) that have been getting cheaper over the years. However, image augmentations are typically executed on central processing units (CPUs). While a GPU is processing a batch of images, the next batch is being augmented on a CPU using multiprocessing, such that each image is transformed in a separate process. As GPUs are getting faster, execution of image transforms on a CPU can become a performance bottleneck. Thus, to fully utilize the power of modern GPUs, augmentations on CPUs have to be fast enough and the speed of each transform operation is important. Recently, implementations of GPU-based image augmentations have been presented; however, the full advantage of using these approaches can only be achieved in a setup with a relatively high GPU/CPU core ratio. On the software side, although Python has become a lingua franca in the machine learning community, it is well known that the Python interpreter is not very efficient for executing computation-heavy algorithms. In this study uniform image size of 224X224 was used,2000 images were used for training,500 images for validation and 500 images for testing the model.

Classification

VGGNet16

This step trains images of nutrient deficiency symptoms. We use 80% data for training and the remaining 20% data for testing - a detailed description of the deep learning algorithms is provided in the following subsections. VGGNet is a CNN jointly developed by the Visual Geometry Group at the University of Oxford and Google Deep Mind. As shown in figure, VGGNet 16 architecture can be considered an extended AlexNet, characterized by 3 x 3 convolutional kernels and 2 x 2 pooling layers, and the network architecture can be deepened by using smaller convolutional layers to enhance feature learning. The two most common current VGGNet version is VGGNet-16. Figure 2demonstrates that inception architecture contains convolutional 1 x 1, 3 x 3, and 5 x 5 kernels with maximum pooling 3 x 3 stacking. Different convolutional kernels sizes are used for feature extraction and connection to increase network width and enhance adaptability to different sizes. The 3 x 3 and 5 x 5 convolutional kernels are preceded by 1 x 1 convolutional kernels for dimensionality and parameter size reduction, reducing computing volume and correcting nonlinear functions. Finally, a 1 x 1 convolution is added after 3 x 3 maximum pooling. Figure 2 shows VGGNet 16 architecture. We can display image samples from the test set and their classification results. We observed that the models were capable of accurately recognizing the target classes.

ResNet50 Classification

A Residual Neural Network (ResNet) is an Artificial Neural Network (ANN) of a kind that stacks residual blocks on top of each other to form a network. Deep residual nets make use of residual blocks to improve the accuracy of the models. The concept of "skip connections," which lies at the core of the residual blocks, is the strength of this type of neural network. The skip connections add the outputs from previous layers to the outputs of stacked layers, making it possible to train much deeper networks than previously possible. ResNet(He et al., 2016)solves the vanishing gradient problem in deeper networks using shortcut connections where the gradient reaches earlier layers and compositions of features at varying depth can be combined to improve performance. ResNet relies on many stacked residual units that are composed of convolution and pooling layers; it therefore acts as the building block to construct the network. The structure of ResNet consists of residual blocks, each of which is concatenated by three convolutions of 1 × 1, 3 × 3, and 1 × 1 kernels. The residual blocks are then converged by average pooling and classified using the softmax function. A total of 80% of the dataset was used for training and 20% for validation. The ResNet50 utilized the transfer learning by modifying the pre-trained VGGNet 16 for the identification task of plant leaf diseases.

Image Analysis

A fully automatic segmentation method for plant leaf images in a complex background was used for image segmentation. First, we used a vein enhancement and then extraction operation to obtain an accurate foreground marker image. Then, the marker-controlled watershed method was used to realize image segmentation. A Confusion matrix that depicts the class of each occurrence depending on the classifier methods used, opening the way for various performance indicators to identify the tendency of the system. The parameters of the confusion matrix are based on the number of groups. Actual Class labels are mentioned in columns and predicted in rows. Each cell is classified as True positive, True Negative, False Positive, and False Negative.

RESULTS AND DISCUSSION

The experiments were performed on a Windows10 desktop equipped with one Intel Core i9 7920X CPU with 64 GB RAM, accelerated by two GeForce GTX 1080Ti GPUs with 11 GB memory. The model implementation was powered by the Keras and Image Data Generator functions back end. Model performance was evaluated three times, expressed as the average accuracy of training and validation, and graphically depicted for each model. The Adam optimizer was used to accelerate the training process. Images were resized through Python Image Library to a specific size based on the model requirement. Repeated experiments comparing different learning rates (0.001, 0.0001, 0.00006, 0.00003, and 0.00001) showed that the learning rate of 0.00001 was most suitable for the model to run 50 epochs for training, and no decay was used.

Approach Analysis

This study compared two state-of-the-art DCNNs to evaluate the performance of image recognition techniques in identifying nutrient deficiencies in cotton. The VGGNet-16 with 13 layers and, ResNet with 50 layers were effectively fitted(Figure 3). After fine-tuning, The ResNet50 model achieved average training, validation, and test accuracies of over 97% and yielded average kappa scores of over 0.97, which was much higher than VGGNet-16.From the perspective of approach process, ResNet-50showed a slow increase in its test and validation accuracies, which might be due to the huge number of parameters in this model compared with VGGNet-16. Thus, during back propagation, the pre-trained parameters of ResNet50-Largedata sets were updated slowly to obtain good generalization ability. Moreover, the ResNet50 was able to adequately fit the data, while the VGGNet-16 seemed to give an over fitting. The possible reason is that some of the labeled images had complex background where the outline data would easily lead to over fitting in the VGGNet-16. In contrast, theResNet50 approach can synthesize local receptive field in higher-level networks.

Qualitative Analysis.

Since ResNet50 performed better than VGGNet-16, one can use this model for qualitative analysis. Three indices were calculated to gain a better understanding of the model's prediction accuracy. The recall refers to the ratio of correctly predicted positive observations to the all observations in an actual class. The precision refers to the ratio of correctly predicted positive observations to the total predicted positive observations. TheF1-score refers to the weighted average of precision and recall, which therefore considers both false positives and false negatives; F1 is usually more useful, especially for an uneven class distribution, albeit not as intuitively understandable as accuracy. Table 6 gives the good prediction results for –N, –P, –K, –Ca, –Mg, –Mn, –Zn, and –B, with f1-scores of over 0.97. Deficiency is a relative concept, and a slight deficiency might be mistaken for full nutrition. In this study, another area for misclassification was among Fe, Mn, and Zn deficiencies which all shared some common symptoms of chlorosis. The nutrients are directly or indirectly related to chlorophyll formation or photosynthesis, the disruption of which generally causes chlorosis (Watchareeruetai et al., 2018). Furthermore, N deficiency was misclassified as S deficiency as both of them caused chlorosis in cotton leaves. These noticeable values can be extracted from the confusion matrix (Figure 4).

Application Analysis

ResNet50 demonstrate powerful capabilities in image recognition. Open source development frameworks lower the barriers to the application, as their versatile platform portability greatly facilitates the progression from concepts and plans to results and applications. New vision-problem applications can often use the architectures of networks already published in the literature alongside open source implementation to ease development, as prior studies might have solved various detailed technical problems such as the learning rate decay schedule or the hyper parameters. Optimizing hyper parameter settings is a significant challenge owing to the enormous time cost. Automatic model design represents a good solution as increasing numbers of applications are developed and shared (Pham et al., 2018).Although some DCNNs can rescale image size, it is necessary to pay attention to the spatial resolution conditions of the cotton leaf images. If the region of the identified object is too small in the overall image, the recognition accuracy will be affected. In addition, the background image can affect the recognition accuracy, especially in cases of multiclass identification. Unlike image recognition tasks involving the identification of people or car objects, the identification of nutrient deficiencies in cotton leaves involves discerning subtle differences of texture in often similar images. Recognizing nutritional deficiencies in cotton should consider surface texture as an identification feature, because this study aims to identify multiple images of nutrition deficiencies in cotton. As compared with other datasets that are based on expert knowledge, the symptoms manifesting in the sand culture experiments would be more precise, because other factors such as pests and diseases are eliminated under controlled conditions and the data cover the entire cotton growing period.

However, we did not consider combinations of more than one deficiency factor in this study, which reduced the robustness of the model. Sand culture experiments represent a time and resource intense means of data collection to build a model with generalized ability. Images alone are always insufficient for supervised classification, so any application should employ data augmentation techniques such as cropping, rotating, and flipping before running recognition processes (Perez and Wang., 2017). The application side should include a label function that uploads the confirmed prediction result to augment the dataset. As similar symptoms can lead to misclassification, offering the top-three predictions would be better than providing only one. Moreover, the symptoms associated with insect-pests and diseases are similar to the visual characteristics of nutrient deficiencies (Barbedo., 2016); thus, combined studies are needed to gain better insight into the identification of practical problems. This study in the short term will optimize the models and datasets for diagnosis of nutrient deficiencies in cotton. It can then be integrated into a mobile diagnosis system to facilitate cotton production by smallholder farmers. In the long run, if a model with greater generalization ability is proposed, the permissions of the mobile users to upload results with locations would provide a vast dataset to aid digital soil mapping and fertilization assessment from a macro perspective.

CONCLUSION

Different nutrient deficiencies alter the morphological characteristics of plant leaves in cotton. In this study, two DCNNs, viz., VGG16 and ResNet50 were used to diagnose various nutrient deficiencies in cotton plants based on image recognition using the dataset collected from sand culture experiment. ResNet50 obtained accuracies of over 90% and outperformed VGGNet-16.The best result was obtained using ResNet50 with the validation accuracy of 97.00% as compared VGGNet-16, which recorded the accuracy of 69.9%. These findings demonstrate that between the two DCNN models, ResNet50gives promising results for fully automatic classification of nutrient deficiencies in cotton.

Confusion Matrix

Confusion Matrix of Resnet50and VGG16 are given below, Figure 4 (a) Confusion matrix of Resnet50, Figure 4. (b) Confusion matrix of VGG16.

Classification Report of Rsenet50and VGG16

Model Accuracy: 97%Model Accuracy: 69.86%, Resnet 50 ,VGG16

Accuracy Graph of Resnet50 and VGG16
Figure 5 (a): Resnet50, Figure 5 (b): VGG16

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Table 1: Parameters

Parameters	VGG16	ResNet50
No. of Convolution layers	13	48
Optimizer	Adam	Adam
Learning Rate	0.001	0.001
Drop out	0.3	-
Activation Function	ReLU	ReLU
Loss Function	Categorical CrossEntropy	Categorical CrossEntropy
Accuracy		97%

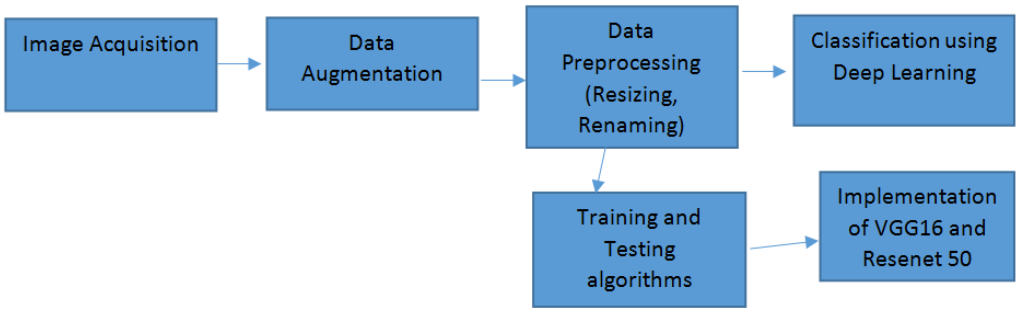


Figure 1: Proposed Architecture of plant deficiency classification

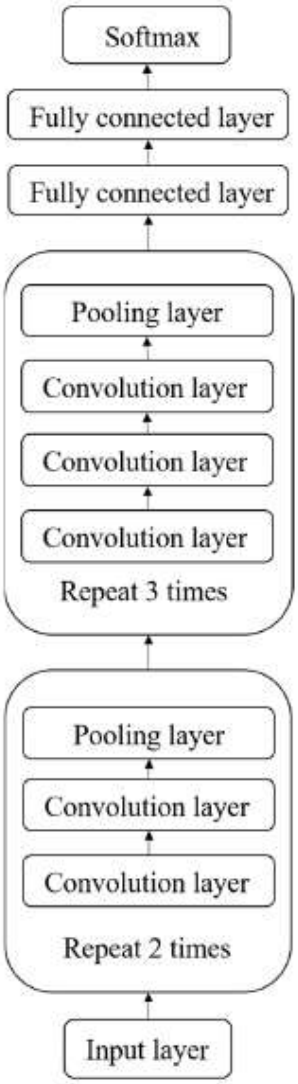


Figure 2: Proposed VGGNet 16.

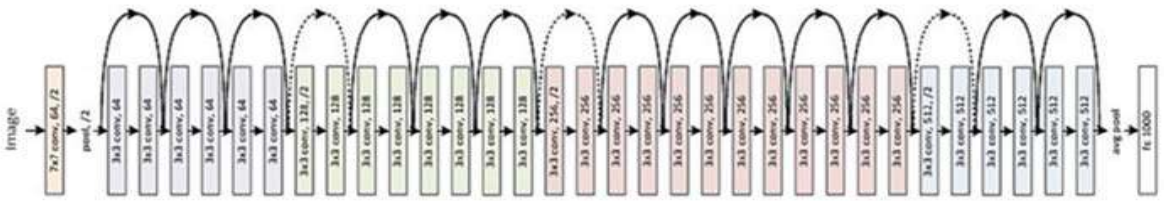


Figure 3: Proposed ResNet50

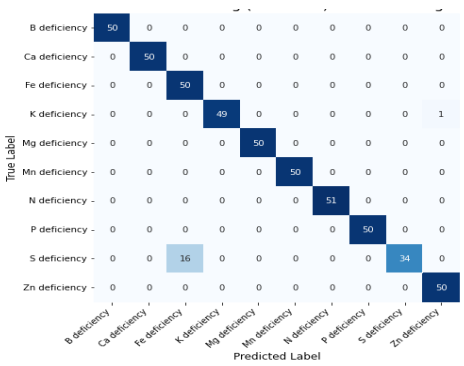


Figure 4 (a) Confusion matrix of Resnet50

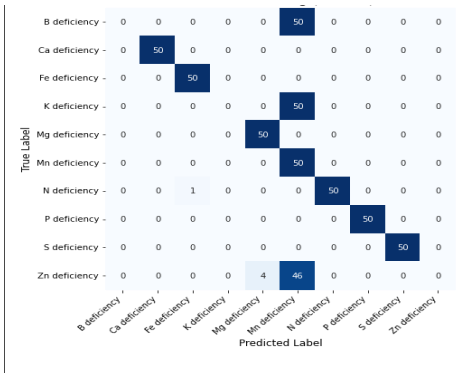
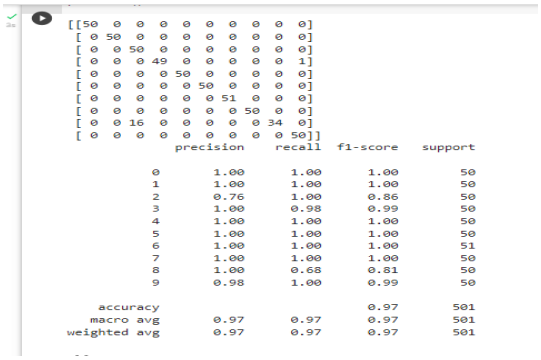


Figure 4. (b) Confusion matrix of VGG16



```
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 [ 0  0 50  0  0  0  0  0  0  0]
 [ 0  0  0 49  0  0  0  0  0  1]
 [ 0  0  0  0 50  0  0  0  0  0]
 [ 0  0  0  0  0 50  0  0  0  0]
 [ 0  0  0  0  0  0 51  0  0  0]
 [ 0  0  0  0  0  0  0 50  0  0]
 [ 0  0 16  0  0  0  0  0 34  0]
 [ 0  0  0  0  0  0  0  0  0 50]]
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        50
           1       1.00      1.00      1.00        50
           2       0.76      1.00      0.86        50
           3       1.00      0.98      0.99        50
           4       1.00      1.00      1.00        50
           5       1.00      1.00      1.00        50
           6       1.00      1.00      1.00        51
           7       1.00      1.00      1.00        50
           8       1.00      0.68      0.81        50
           9       0.98      1.00      0.99        50

    accuracy                           0.97       501
   macro avg       0.97      0.97      0.97       501
weighted avg       0.97      0.97      0.97       501
```

Figure 5 : Resnet 50(a)

```
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 [ 0 50  0  0  0  0  0  0  0  0]
 [ 0  0 50  0  0  0  0  0  0  0]
 [ 0  0  0  0  0 50  0  0  0  0]
 [ 0  0  0  0 50  0  0  0  0  0]
 [ 0  0  0  0  0 50  0  0  0  0]
 [ 0  0  1  0  0  0 50  0  0  0]
 [ 0  0  0  0  0  0  0 50  0  0]
 [ 0  0  0  0  0  0  0  0 50  0]
 [ 0  0  0  0  0  4 46  0  0  0]]
              precision    recall  f1-score   support

           0       0.00      0.00      0.00        50
           1       1.00      1.00      1.00        50
           2       0.98      1.00      0.99        50
           3       0.00      0.00      0.00        50
           4       0.93      1.00      0.96        50
           5       0.26      1.00      0.41        50
           6       1.00      0.98      0.99        51
           7       1.00      1.00      1.00        50
           8       1.00      1.00      1.00        50
           9       0.00      0.00      0.00        50

    accuracy                           0.70       501
```

Figure 5: VGG16(b)

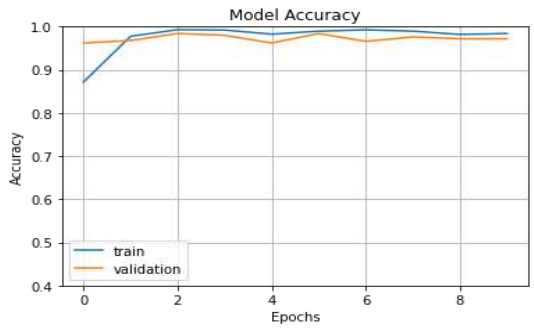

Figure 6 (a): Resnet50

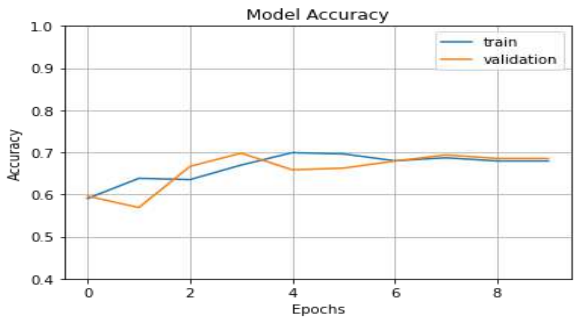

Figure 6 (b): VGG16

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Intuitionistic Fuzzy Generalized $^{\#}\alpha$-Continuous in Intuitionistic Fuzzy Topological Spaces

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ABSTRACT

The primary aim of this prospectus is to introduce and study the basic properties of Intuitionistic fuzzy generalized $^{\#}\alpha$-continuous, Intuitionistic fuzzy generalized $^{\#}\alpha$-irresolute.

Keywords: IFS, IFT, IFG $^{\#}\alpha$CM, IFG $^{\#}\alpha$IF.
Mathematics Subject Classification: 54A40.

INTRODUCTION

The concept of fuzzy sets was introduced by Zadeh[8] and later Atanasov[1] generalized this idea to intuitionsistic fuzzy sets using the notion of fuzzy sets. On the other hand Coker[2] introduced intuitionistic fuzzy topological spaces using the notion of intuitionistic fuzzy sets. In this paper we introduce intuitionistic fuzzy generalized $^{\#}\alpha$-Continuous mapping and intuitionistic fuzzy generalized $^{\#}\alpha$- Irresolute functions and study some of their properties.

PRELIMINARIES

Definition 4.6. [2] A mapping h from E into F is said to be intuitionistic fuzzy continuous(IF continuous for short) mapping if $h^{-1}(D) \in IFO(E)$ for every D.
Definition 4.7. [3], [4] A mapping h from E to F said to be an,
(1) Intuitionistic fuzzy semi continuous if $h^{-1}(D) \in IFSO(E)$ for all D.

(2) Intuitionistic fuzzy α-continuous if $h^{-1}(D) \in IF\alpha O(E)$ for all D.
(3) Intuitionistic fuzzy pre continuous if $h^{-1}(D) \in IFPO(E)$ for all D.

Definition 4.8. [6] Let h: E → F is proposed to be intuitionistic fuzzy generalized continuous mapping if $h^{-1}(D) \in IFGC(E)$ for all IFCS D in F.
Definition 4.9. [**5**] Let h: E→F is proposed to be intuitionistic fuzzy semi-pre continuous mapping if $h^{-1}(D) \in IFSPO(E)$ for all D.
Definition 4.10. [7]Let h: E →F is proposed to be intuitionistic fuzzy irresolute if $h^{-1}(D) \in IFCS(E)$ for all IFCS D in F.

Intuitionistic Fuzzy Generalized $^{\#}\alpha$-Continuous Mapping

In this section we introduce intuitionistic fuzzy generalized $^{\#}\alpha$- continuous mapping and investigate some of its properties.

Definition 5.1. A mapping h: (E, τ) → (F, σ) is called an intuitionistic fuzzy generalized $^{\#}\alpha$- continuous (IFG$^{\#}\alpha$- continuous for short) mapping
if $h^{-1}(C)$ is an IFG$^{\#}\alpha$CS in (E, τ) for every IFCS C of (F, σ).

Example 5.2. Let E= {p, q}, F ={r, s} and J_1= < e, (0.4_p, 0.3_q), (0.4_p, 0.5_q >, J_2= < f, (0.1_r, 0_s), (0.7_r, 0.8_s) >. Then τ = {$0_{\sim}$, J_1 ,$1_{\sim}$} and σ = {$0_{\sim}$,J_2, $1_{\sim}$ } are IFTs on E and F respectively. Define a mapping h: (E, τ) →(F, σ) by h(p) = r and h(q) = s. Then h is an IFG$^{\#}\alpha$-continuous mapping.

Theorem 5.3. Every IF continuous mapping is an IFG$^{\#}\alpha$-continuous mapping but not conversely.
Proof: Let h: (E, τ)→(F, σ) be an IF continuous mapping. Let C be an IFCS in F. Then $h^{-1}(C)$ is an IFCS in E. Since every IFCS is an IFG$^{\#}\alpha$CS, $h^{-1}(C)$ isan IFG$^{\#}\alpha$CS in E. Hence h is an IFG$^{\#}\alpha$-continuous mapping.

Example 5.4. Let E={p,q}, F={r,s} and J_1= < e, (0.7_p, 0.6_q), (0.3_p, (0.2_q) >, J_2=< f, (0.4_r, 0.6_s), (0.4_r, 0.2_s)>. Then τ ={$0_{\sim}$, J_1, $1_{\sim}$} and σ = {$0_{\sim}$, J_2, $0_{\sim}$} are IFTs on E and F respectively. Define a mapping h: (E, τ)→(F, σ) by h(p) = r and h(q) = s. Then h is an IFG$^{\#}\alpha$- continuous mapping but not an IF continuous mapping, since $h^{-1}(J_2)$ = < e, (0.4_p, 0.6_q, (0.4_p, 0.2_q) > is not anIFOS in E.

Theorem 5.5. Every IFα continuous mapping is an IFG$^{\#}\alpha$- continuous mappingbut not conversely.
Proof: Let h: (E, τ)→(F, σ) be an IF continuous mapping. Let C be an IFCS in F. Then $h^{-1}(C)$ is an IFCS in E. Since every IFαCS is an IFG$^{\#}\alpha$CS, h^{-1} (C) isan IFG$^{\#}\alpha$CS in E. Hence h is an IFG$^{\#}\alpha$-continuous mapping.

Example 5.6. Let E={p,q}, F={r,s} and J_1= < e, (0.4_p, 0.5_q), (0.6_p, 0.5_q) >, J_2= < f, (0.7_r, 0.6_s), (0.3_r, 0.4_s) >. Then τ = {$0_{\sim}$, J_1 , $1_{\sim}$ } and σ = {$0_{\sim}$, J_2 ,$1_{\sim}$ are IFTs on E and F respectively. Define a mapping h: (E, τ)→ (*F*, σ) by h(p) = r and h(q) = s. Then *h* is an IFG#α- continuous mapping but not an IFα-continuous mapping, since $h^{-1}(J_2)$ = < e, (0.7_p, 0.6_q), (0.3_p, 0.4_q) > int(cl(int($h^{-1}(J_2)$))) =J^c.

Theorem 5.7. Every IFRCS continuous mapping is an IFG$^{\#}\alpha$- continuous mapping but not conversely.
Proof: Let h: (E, τ)→(F, σ) be an IF continuous mapping. Let C be an IFCS in F. Then $h^{-1}(C)$ is an IFCS in E. Since every IFRCS is an IFG#αCS, h–1 (C) is an IFG#αCS in E. Hence h is an IFG#α-continuous mapping.

Example 5.8. Let E={p_2q}, F={r,s} and J_1= < e, (0.4_p, 0.5_q), (0.6_p, 0.5_q) >, J_2= < f, (0.7_r, 0.6_s), (0.3_r, 0.4_s) >. Then τ = {$0_\sim$, J_1 ,$1_\sim$ } and σ = {$0_\sim$, J_2 ,$1_\sim$}are IFTs on E and F respectively. Define a mapping h: (E, τ)→(F, σ) by h(p) = r and h(q) = s. Then h is an IFG$^\#\alpha$- continuous mapping but not an IFR-continuous mapping, since $h^{-1}(J_2)^c$ = < e, (0.3_p, 0.4_q), (0.7_p, 0.6_q), > ≠ cl(int($h^{-1}(J^c)$)))).

Theorem 5.9. Every IFG$^\#\alpha$- continuous mapping is an IFSG- continuous mapping but not conversely.

Proof: Let h: (E, τ)→(F, σ) be an IF continuous mapping. Let C be an IFCS in F. Then h −1(C) is an IFCS in E. Since every IFG#αCS is an IFSGCS, h−1 (C) is an IFSGCS in E. Hence h is an IFSG-continuous mapping.

Example 5.10. Let E={p,q}, F={r,s} and J_1= < e, (0.1_p, 0.2_q), (0.3_p, 0.4_q)>, J_2= < f, (0.4_r, 0.5_s), (0.1_r, 0_s) >. Then τ = {$0_\sim$, J_1 ,$1_\sim$ } and σ = {$0_\sim$, J_2 ,$1_\sim$}are IFTs on E and F respectively. Define a mapping h: (E, τ)→(F,σ) by h(p) = r and h(q) = s. Then h is an IFSG- continuous mapping but not an IFG$^\#\alpha$-continuous mapping, since $h^{-1}(J_2)$ = < e, (0.4_p, 0.5_q), (0.1_p, 0_q)> ⊄ cl(int($h^{-1}(J_2)$))=J_1.

Theorem 5.11. Every IFG$^\#\alpha$- continuous mapping is an IFGS- continuous mapping but not conversely.

Proof: Let h: (E, τ)→(F, σ) be an IF continuous mapping. Let C be an IFCS in F. Then h−1(C) is an IFCS in E. Since every IFG#αCS is an IFGSCS, h−1 (C) is an IFGSCS in E. Hence h is an IFGS-continuous mapping.

Example 5.12. Let E={p,q}, F={r,s} and J_1= < e, (0.3_p, 0.4_q), (0.5_p, 0.6_q) >, J_2= <f, (0.6_r, 0.7_s), (0.2_r, 0.1_s)>. Then τ = {$0_\sim$,J_1,$1_\sim$} and σ = {$0_\sim$,J_2 ,$1_\sim$ } are IFTs on E and F respectively. Define a mapping h: (E, τ)→(F, σ) by h(p) = r and h(q) = s. Then h is an IFGS- continuous mapping but not an IFG$^\#\alpha$-continuous mapping, since $h^{-1}(J_2)$ = < e, (0.6_p, 0.7_q), (0.2_p, 0.1_q) >⊄cl(int($h^{-1}(J_2)$))=J_1.

Theorem 5.13. Every IFG$^\#\alpha$- continuous mapping is an IFGSR- continuous mapping but not conversely.

Proof: Let h: (E, τ)→(F, σ) be an IF continuous mapping. Let C be an IFCS in F. Then h −1(C) is an IFCS in E. Since every IFG#αCS is an IFGSRCS, h−1(C) is an IFGSRCS in E. Hence h is an IFGSR-continuous mapping.

Example 5.14. Let E={p,q}, F={r,s} and J1= < e, (0.1p, 0.2q), (0.4p, 0.5q) >, J2= < f, (0.5r, 0.6s), (0r, 0.1s) >. Then τ = {0~ , J1 ,1~ } and σ = {0~, J2 ,1 }are IFTs on E and F respectively. Define a mapping h: (E, τ)→(F, σ) by h(p) = r and h(q) = s. Then h is an IFGSR- continuous mapping but not an IFG#α-continuous mapping, since h −1(J2) = < e, (0.5p, 0.6q), (0p, 0.1q) > ⊄cl(int(f−1(J2))))=J1.

Theorem 5.15. A mapping h: (E, τ)→(F, σ) is an IFG#α- continuous mapping if and only if the inverse image of each IFOS in F is an IFG#αOS in E.

Proof: The proof is obvious since $h^{-1}(C)^c = (h^{-1}(C))^c$

Theorem 5.16. A mapping h: (E, τ)→(F, σ) is an IFG$^\#\alpha$-continuous if and only if the inverse image of every IFOS in F is an IFG$^\#\alpha$OS in E.

Proof: **Necessary Part:** Let C be an IFOS in F. This implies C^c is an IFCS in F. Since h is an IFG$^\#\alpha$-continuous, $h^{-1}(C^c)$ is an IFG$^\#\alpha$CS in E. Since $h^{-1}(C^c)$ =$(h^{-1}(C))^c$, $h^{-1}(D)$ is an IFG$^\#\alpha$OS in E. Hence the inverse image of an IFOS inF is an IFG$^\#\alpha$OS in E.

Sufficient Part: Let C be an IFCS in F. Then C^c is an IFOS in F. By hypothesis, $h^{-1}(C^c)$ is an IFG$^{\#}\alpha$OS in E. Since $h^{-1}(C^c)=(h^{-1}(C))^c$, $h^{-1}(C)$ is an IFG$^{\#}\alpha$CS in E. Hence h is an IFG$^{\#}\alpha$-continuous function.

Theorem 5.17. Let h: $(E,\tau)\to(F,\sigma)$ be an intuitionistic fuzzy g$^{\#}\alpha$-continuous mapping. Then the following statement hold.
(1). $h(IFe^{\#}\alpha cl(C)) \subseteq cl(h(C))$, for every intuitionistic fuzzy set C in E.
$IFg^{\#}\alpha cl(h^{-1}(D))\subseteq h^{-1}(cl(D))$ for every intuitionistic fuzzy set D in F.
Proof: (1) Let C E. Then cl(h(C)) is an intuitionistic fuzzy closed set in F. Since h is intuitionistic fuzzy g$^{\#}\alpha$-continuous, $h^{-1}(cl(h(C)))$ is intuitionistic fuzzy g$^{\#}\alpha$- closed in E. Since $C \subseteq h^{-1}(h(C))\subseteq h^{-1}(cl(h(C)))$ and $h^{-1}(cl(h(C)))$ is intuitionistic fuzzy g$^{\#}\alpha$- closed, implies $IFg^{\#}\alpha cl(C) \subseteq h^{-1}(cl(h(C)))$. Hence $h(IFg^{\#}\alpha cl(C)) \subseteq cl(h(C))$.

(2) Replacing C by $h^{-1}(D)$ in (1), we get $h(IFg^{\#}\alpha cl(h^{-1}(D)))\subseteq cl(h(h^{-1}(D))) = cl(D)h(IFg^{\#}\alpha cl(h^{-1}(D))) \subseteq cl(D)$. Hence $IFg^{\#}\alpha cl(h^{-1}(D)) \subseteq h^{-1}(cl(D))$.

Theorem 5.18. Let $h : E \to F$ is intuitionistic fuzzy g$^{\#}\alpha$-continuous mapping and e: F→ G is intuitionistic fuzzy continuous, then $eoh : E\to G$ is intuitionistic fuzzy g$^{\#}\alpha$-continuous.
Proof: Let D be any intuitionistic fuzzy closed set in G. Since e is intuitionistic fuzzy continuous, $e^{-1}(D)$ is intuitionistic fuzzy closed set in F. Since h is intuitionistic fuzzy g$^{\#}\alpha$-continuous mapping $h^{-1}[e^{-1}(D)]$ is an intuitionistic fuzzy g$^{\#}\alpha$- closed set in E. $(h \circ e)^{-1}(D) = h^{-1}(e^{-1}(D))$ is intuitionistic fuzzy g$^{\#}\alpha$-closed set, for every intuitionistic fuzzy closed D in G. Hence e *o* h is intuitionistic fuzzy g$^{\#}\alpha$-continuous mapping.

Intuitionistic Fuzzy Generalized $^{\#}\alpha$-Irresolute Function

Definition 6.1. A mapping h: E → F from an IFTS E into an IFTS F is said to be intuitionistic fuzzy g$^{\#}\alpha$-irresolute if $f^{-1}(B)$ is an IFG$^{\#}\alpha$CS in E for every IFG$^{\#}\alpha$CS D in F.

Theorem 6.2. Let h: E →F is a mapping from an IFTS E into an IFTS F. Then every intuitionistic fuzzy g$^{\#}\alpha$- irresolute mapping is intuitionistic fuzzy g$^{\#}\alpha$- continuous.
Proof: Assume that h: E⟶F is an intuitionistic fuzzy g$^{\#}\alpha$- irresolute mapping and let D be an IFCS in F. Since every intuitionistic fuzzy closed set is an intuitionistic fuzzy g#α-closed. Therefore D is an IFG#αCS in F. Since h is intuitionistic fuzzy g#α-irresolute, by definition h−1(D) is IFG#αCS in E. Hence h is intuitionistic fuzzy g#α-continuous.

Example 6.3. Let E={p, q}, F={r, s} and J1= < e, (0.1p, 0.2q), (0.4p, 0.5q) >, J2= < f, (0.5r, 0.6s), (0r, 0.1s) >. Then τ = {0~ , J1 ,1~ } and σ = {0~ , J2 ,1~} are IFTs on E and F respectively. Define a mapping h: (E, τ)→(F, σ) by h(p) = r and h(q) = s. Then h is an IFGSR- continuous mapping but not an IFG#α-continuous mapping, since h−1(J2) = < e, (0.5p, 0.6q), (0p, 0.1q) > ⊈ cl(int(h−1(J2))))=J1.

Theorem 6.4. Let h: E → F be a mapping from a IFTS E into an IFTS F. Then the following statements are equivalent. h is intuitionistic fuzzy g#α-irresolute mapping. h−1(D) is an IFG#αOS in E, for every IFG#αOS D in E.
Proof: Necessary Part: Let C be an IFOS in F. This implies C^c is an IFCS in F. Since h is an IFG#α-irresolute, $h^{-1}(C^c)$ is an IFG#αCS in E. Since $h^{-1}(C^c) = (h^{-1}(C))^c$, $h^{-1}(D)$ is an IFG#αOS in E. Hence the inverse image of an IFOS in F is an IFG#αOS in E.
Sufficient Part: Let C be an IFCS in F. Then C^c is an IFOS in F. By hypothesis, $h^{-1}(C^c)$ is an IFG#αOS in E. Since $h^{-1}(C^c)=(h^{-1}©)c$, h^{-1} © is an IFG#αCS in E. Hence h is an IFG#α-irrselote function.

Theorem 6.5. If a mapping h : E → F is intuitionistic fuzzy g#α- irresolute mapping, then h (Ifg#αcl(D)) ⊆ αcl(h(D)) for every IFS D of E.
Proof: Let D be an IFS of E. Since αcl(h(D)) is an IFG#αCS in F, by our assumption $h^{-1}(\alpha cl(h(D)))$ is an IFG#αCS in E. Furthermore $D \subseteq h^{-1}(h(D)) \subseteq h^{-1}(\alpha cl(h(D)))$ and hence $Ifg\#\alpha cl(D) \subseteq h^{-1}(\alpha cl(h(D)))$ and consequently $h(Ifg\#\alpha cl(D)) \subseteq h(h^{-1}((h(D)))) \subseteq (h(D))$.

Theorem 6.6. Let h: E→F and e: F→ G are intuitionistic fuzzy g#α-irresolute mappings, where E,F,G are IFTS. Then e o h is an intuitionsitic fuzzy g#α-irresolute mapping.
Proof: Let D be an intuitionistic fuzzy g#α-closed set in G. Since e is an intuitionistic fuzzy g#α irresolute mapping, e−1(D) is an intuitionistic fuzzy g#α-closed set in F . Also since h is intuitionistic fuzzy g#α irresolute mapping, h −1(e−1(D)) is an intuitionistic fuzzy g#α-closed set in E. $(eoh)^{-1}(D) = h^{-1}(e^{-1}(D))$ for each D in G. Hence $(e \circ h)^{-1}(D)$ is an intuitionistic fuzzy g#α-closed set in E. Therefore eoh is an intuitionistic fuzzy g#α irresolute mapping.

Theorem 6.7. Let (E, τ), (F, σ), (G, δ) be any intuitionistic fuzzy topological spaces. Let h : (E, τ) → (F, σ) be intuitionistic fuzzy $g^{\#}\alpha$ irresolute and e : (F, τ) → (G, δ) is intuitionistic fuzzy continuous, then e *o* h is intuitionistic fuzzy $g^{\#}\alpha$ continuous.
Proof. Let D be any intuitionistic fuzzy closed set in G. Since e is intuitionistic fuzzy continuous, $e^{-1}(D)$ is IFCS in F. Since every IFCS is an IFG$^{\#}\alpha$CS. Therefore $h^{-1}(D)$ is an IFG$^{\#}\alpha$CS in F. But since h is an intuitionistic fuzzy g#α- irresolute mapping $h^{-1}(e^{-1}(B))$ is an IFG#αCS in E. $(eoh)^{-1}(D) = h^{-1}(e^{-1}(D))$ is IFG#αCS in E. Hence eoh is intuitionistic fuzzy $g^{\#}\alpha$-continuous.

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RESEARCH ARTICLE

Ethnomedicinal Plants Utilized by Dental and Oral Care of the Irula Tribes, Kozhikari Village, Kotagiri, The Nilgiris, Tamil Nadu, India.

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ABSTRACT

The present study is about the plant species used for the oral care among indigenous communities of Irula Tribal, Kozhikarai village, Kotagiri, the Nilgiris, Tamil nadu. Thirty plant species belonging to twenty four families were identified in this study. Oral diseases are common for all human beings, but tribal people who are living in forest area, lacking awareness of tooth care and hygiene it is an important problem. The present study about the medicinal plants used by the Irula tribal people in the treatment of toothache and general oral problems.

Keywords: Irula tribal, Kozhikarai village, Nilgiris, Medicinal plants, Oral care.

INTRODUCTION

Plants have been reported to be the source of around a quarter of the common medications used around the world for ages[1],[2]. The top 252 medications in conventional drug formulations are all derived from plants[3]. Because indigenous peoples are a more dependable source of medical plant information[4]. ethno botanical information has gotten a lot of attention in medicinal plant research in the last few decades[5]. In recent decades, documentation of ethno medicinal species for scientific confirmation and subsequent processing for commercialization has gained relevance in India[6],[7],[8],[9],[10]. Ethnomedicine is a scientific discipline concerned with the cultural interpretation of health, disease, and illness. It also covers the process of seeking medical help and healing[11],[12],[13]. Plant-based, environmental-based, and spiritual healing are the three categories of ethno medicine[14]. A tooth infection is as common as a flu bug or a nose bleed; almost everyone has experienced one at some point in their lives. An

apparently wild tooth infection, on the other hand, offers a world of misery, primarily in the form of constant jaw pain and difficulty eating our favourite meals. A tooth abscess or dental abscess is another name for a tooth infection. It happens when a bacterial infection causes pus to accumulate in various locations of the tooth, as well as the surrounding gum tissues. The present report is about the ethno medicinal information gathered from Irula tribal of Kozhikrai village, Kotagiri, the Nilgiris, Tamil Nadu. The Western Ghats of Tamilnadu are ethno botanically extremely rich in medicinal plant diversity. The Nilgiri hills, sometimes known as "the blue mountains," are located in Tamil Nadu's Western Ghats, between 11o, 12o and 11o, 43o North and 76o, 14o and 77o, 1o East. The hills are part of mountain ranges that cover 2,543 square kilometres. The area's basic geography is undulating hills and raised hands, ranging in elevation from 350 to 2,623 metres above sea level. It is distinguished by a diverse and rich flora and fauna that spans the tropical to temperate zones[15],[16].

MATERIALS AND METHODS

A survey was done between January 2020 and February 2021 to determine which plants were utilised to make medications for dental disorders by the Irula tribe people. Many Irula tribal people, mainly Vaidya of Irula tribes, were interviewed for this study, and the approach described by[17]. was used to obtain the data. The therapeutic herbs were used to create herbarium specimens. The department herbarium received the prepared herbarium specimens.

RESULTS AND DISCUSSION

A total of 30 plant species from twenty-four families were identified as being used for oral hygiene. The family Asteraceae has the most species (3), followed by Combretaceae, Myrtaceae, Solanaceae, and Moraceae (2 species each), and the remaining 19 families had only one species each (Table -1). Fresh leaves, flowers, stems, bark, fruit, seed, and whole plants are among the materials employed in pharmaceutical formulations (Fig - 1). In comparison to paste, decoction, juice, and raw plants, powder is usually employed in the mode of preparation (Fig -2). Table -1 and Fig. -2 provide a list of thirty plant species from twenty-four groups used by the Irula tribal community to cure oral and dental problems. The leaf powder of *Achyranthus aspera, Acacia arabica, Anacyclus pyrethrum, Areca catechu, Azardirachta indica, Eclipta prostrata*, and other plants was found to be employed as a powder, paste, and decoction for oral and dental care in the current study[18]. identified 12 herbs that can help with oral and dental health. These 12 plants also were also observed in the present investigation also. Similarly *Acacia arabica, Achyranthus aspera, Anacyclus pyrethrum, Annona squamosa, Areca catechu, Azardirachta indica, Bambusa arundincea,Ficus racemosus, Hibiscus rosa-sinensis,Psidium guajava, Solanum surattense, Syzygium aromaticum* are used as powder, paste, and decoction mode except *Bambusa arundinaceae, Hibiscus rosa-sinensis and wrightia tinctoria.* Young stem is also used for cleaning teeth and *Psidium guajava* fruit is used only as internal purposes for dental diseases[19]. reported 5 plants for dental care, and the same 5 plants (*Anacyclus pyrethrum*, *Acacia arabica, Achyranthus aspera, Azardirecta indica, Wrightia tinctoria)* are employed in the current study as powder and paste mode for dental care. The same five plants (*Acacia nilotica, Achyranthus aspera, carica papya, Solanum surrattense, wrightia tintoria*) that [8]. reported for the treatment of dental problems were also seen and used for powder and paste form of dental diseases in the current experiment[20]. described three plants (*Psidium guajava, Solanum surettense,* and *Ficus racemosa*) for the treatment of dental problems, which were used as paste and powder in the current study [21]. described the use of two plant species (*Azardirecta indica and Psidium guajava*) to cure dental disorders. In the current study, these plants were also found in powder and paste form.

CONCLUSION

The current research focuses on the herbal treatments utilised by the Irula people of Kozhikarai hamlet in Kotagiri, Nilgiris, to treat various oral and dental disorders. Ulcers, sores, bleeding gums, swollen gums, bad breath, loose teeth, receding gums, cracked unbroken teeth, and dry mouth were among the oral and dental illnesses identified.

Plant medicine in powder and paste form is used to treat several disorders, and fresh raw plants are also employed in some medicines.

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Table 1. Ethnobotanical information of Herbal Plants used in treatment of dental and oral care diseases.

Botanical Name	Family	Local Name	Parts used	Mode of Preparation	Route of Application	Ailments Treated
Achyranthes aspera L.	Amaranthaceae	Nayuruvi	Leaf and Root	Powder,Paste and Decoction	External	Gum Disorders
Acacia Arabica Willd.	Mimosaceae	Karuvaelam	Bark and young stem	Powder and Decoction	External	Gargle for Toothache and Gum disorder
Allium sativum L.	Liliaceae	Poondu	Bulb	Paste	Internal and External	Gum diseases and Toothache
Anacyclus pyrethrum DC.	Asteraceae	Akarakara	Root	Raw and Powder	External	Gingivitis
Annona squamosa L.	Annonaceae	Seethapalam	Leaf and Stem	Raw and Paste	External	Toothache
Areca catechu L.	Arecaceae	Pakku	Nut	Raw	External	Dentifrice
*Azardirecta indica*A.Juss.	Meliaceae	vepamaram	Leaf and Stem	Paste	External	Pyorrhoea
Bambusa arundinaceae Wild.	Poaceae	Moongil	Young stem	Raw	External	Gum diseases
Bauhinia tomentosa L.	Caesalpiniaceae	Iruvtchi	Root bark	Powder	External	Gum diseases
Cyperus rotundus L.	Cyperaceae	Korai kizhangu	Bulb	Powder and Paste	External	Gum diseases
Eclipta prostrata L.	Asteraceae	Karisalai	Leaf	Paste, powder	Internal and External	Toothache, Bleeding gum and Foetid smell
Ficus racemosa L.	Moraceae	Atthi maram	Bark, stem	Powder	External	Gum diseases
Ficus religiosa Forssk.	Moraceae	Arasamaram	Leaf, stem, bark,	Paste,Powder	External	Mouth sore
Hibiscus rosa –sinensis L.	Malvaceae	Semparuthi	Stem	Raw	External	Toothache, Bleeding gum
Justicia diffusa wild.	Acanthaceae		Leaf and stem.	Paste	External	Bleeding gum and Mouth sore.
Lantana camara L.	Verbenaceae	Unni chedi	Leaf, stem and fruit	Paster and Powder	External	Toothache, Bleeding gum and foetid smell
Mangifera indica L.	Anacardiaceae	Maamaram	Bark	Powder and paste	External	Mouth ulcer and foetid smell
Mentha arvensis L.	Lamiaceae	Pudina	Whole plant	Paste and Decoction	Internal and External	Toothache

Mimosa pudica L.	Fabaceae	Thottal sinungi	Leaf and Root	Paste and Decoction	External	Toothache
Phylanthus emblica L.	Phyllanthaceae	Nellikkai	Fruit	Raw and Juice	Internal	Bleeding gums
Pipper beetle L.	Piperaceae	vetrillai	Leaf	Raw	Internal and External	Foetid smell
Psidum guajava L	Myrtaceae	Koyya	Leaf, Bark and Fruit	Raw	Internal and External	Toothache and foetid smell
Punica granatum L.	Lythraceae	Maathulai	Leaf, Stem and Fruit	Raw and Juice	Internal and External	Toothache and foetid smell
Solanum nigrum L.	Solanaceae	Manathakali	Leaf and fruit	Raw and Decoction	Internal and External	Mouth ulcer
Solanum surattense Burm f.	Solanaceae	Kandangkathari	Seed	Powder, Paste and smoke	External	Gum disorder and tooth pain
Spilanthes urens	Asteraceae	Palvali Poondu	Flower	Raw and Paste	External	Paralysis of tongue and Toothache
Syzygium aromaticum L. Merr,L.M.Perry.	Myrtaceae	Kirambu	Flower bud, Essential oil	Powder and Paste	External	Tooth cavities
Terminalia bellirica (Gaertn). Roxb.	Combretaceae	Thandrikkai	Fruit	Powder and Paste	Internal and External	Toothache,sore throat,Gum bleedings
Terminalia chebula Retz.	Combretaceae	Kadukkai	Fruit	Powder and Paste	Internal and External	Toothache,sore throat and gum bleedings
Wrightia tinctoria (Roxb) R.Br.	Apocyanaceae	Vetpalai	Leaf, young stem	Raw and Paste	External	Toothache

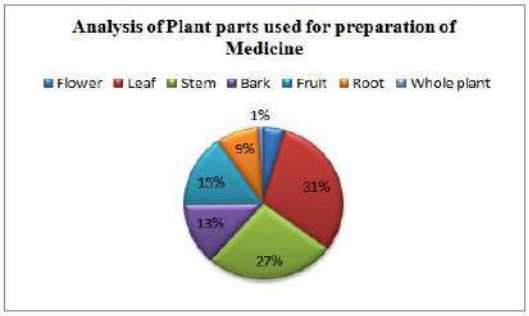

Fig -1. Analysis of Plant parts used for preparation of Medicine

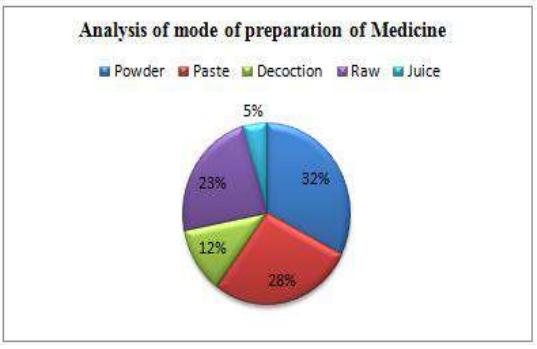

Fig -2. Analysis of mode of preparation of Medicine

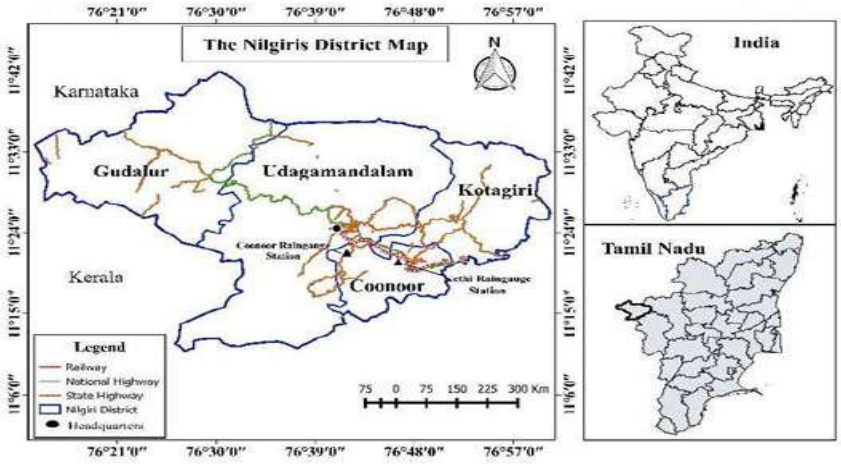

Fig 3: Location map of the Nilgiris district

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RESEARCH ARTICLE

Tg-ma Separation Axioms in Topological Space

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ABSTRACT

Here we present and study the idea of another class of topological space , $T_{g\text{-}ma}$ space and study their relation with topological spaces namely T_0 , T_1 , $T_{1/2}$,T_ω , door spaces and α spaces. Every $T_{g\text{-}ma}$ space is $T_{½}$ space and also $T_{g\text{-}ma}$ space is independent of door space. we also introduce and study new separation axioms namely g-m_a T_o space, g-m_a T_1 space and g-m_a T_2 space and investigate some their properties.
Mathematics Subject Classification**:**54 A05, 54D10 ,54D15

Keywords: $T_{½}$ space , T_0 space, T_1 space, door spaces.

INTRODUCTION

Here we present and study the idea of another class of topological space called $T_{g\text{-}ma}$ space and study their relation with topological spaces namely T_0 , T_1 , $T_{1/2}$,T_ω , door spaces and α spaces. Every $T_{g\text{-}ma}$ space is $T_{½}$ space. Also $T_{g\text{-}ma}$ space is independent of door space. We also introduce and study new separation axioms namely g-m_a T_o space, g-m_a T_1 space and g-m_a T_2 space and investigate some their properties.

Definition 1.1.2 : A topological space (Y,η), is said to be ,
i) a door space[2] if each subset of (Y,η) is either open or closed
ii) a $T_{1/2}$ space[3] if each g-closed subset of (Y,η) is closed

iii) an α space[4] if each α -closed subset of (Y,η) is closed

iv) a $T\omega$ space[5] if each ω-closed subset of (Y,η) is closed

v)A subset M is generalized maximal closed [1] , if cl (M) $\subseteq$ V whenever M $\subseteq$ V &V is a maximal open.

1.2 T g-ma space

Definition 1.2.1 A topological space (Y,η) is $T_{g\text{-}ma}$ space if for each non empty closed set N, N⊂Y is g-m_a closed.

Example 1.2.2 Let Y={i_9, f_9, m_9} &η ={φ,{ i_9},{f_9, m_9},Y}
η - closed ={φ,{i_9},{f_9, m_9},Y}.Clearly (Y,η) is T $_{g\text{-}ma}$ space

Theorem 1.2.3 Every $T_{g\text{-}ma}$ is T ½ space.
Proof : The proof of the theorem leads from the definition 1.2.1 & also every g-m_a closed is a g-closed .
Remark 1.2.4
The converse of the statement needn't be correct, as ascertained below.
Example 1.2.5:i)
Let Y={i_9,f_9,m_9} &η ={φ,{m_9},{i_9,m_9},{f_9,m_9},Y}
η –closed = φ, {i_9},{f_9},{i_9,f_9},Y

η-g-closed = φ, {i_9},{f_9},{i_9,f_9},Y

η –g-m_a closed= φ, {i_9},{f_9}

Clearly Y is T ½ space but not $T_{g\text{-}ma}$ space.

Theorem 1.2.6 Consider Y to be T $_{g\text{-}ma}$& Z be a closed subspace of Y. Then Z is also T $_{g\text{-}ma}$ space.
Proof : The proof of the theorem follows from the definition &the result that if W ⊆ Y is any subspace in (Y, η) & T is maximal open in Y then W ⋂ T is a maximal open in W and ifT ⊆ Z ⊆ Y and T be g-m_a closed in (Y,η) , then T is g-m_a closed relative to Z.

Remark 1.2.7: T $_{g\text{-}ma}$ space is independent of T_0 space.
Example 1.2.8: i) Let Y={i_1,f_1,m_1} &η ={φ,{i_1},Y}. Then clearly Y is T_0 space but not T $_{g\text{-}ma}$ space.
ii) Let Y={i_1,f_1,m_1} &η ={φ,{i_1},{f_1, m_1}, Y}. Clearly Y is $T_{g\text{-}ma}$ but not T_0 space , since $f_1 \neq m_1$& f_1 , $m_1 \in$ Y there does not exist any open set containing f_1 not m_1 or open containing m_1 not f_1.

Theorem 1.2.9 : For a topological space (Y,η) ,
i) Every T_1 space is T $_{g\text{-}ma}$ space
ii) Every T_2 space is T $_{g\text{-}ma}$ space
Proof : The proof is omitted as it is obvious from the definition 1.2.1.

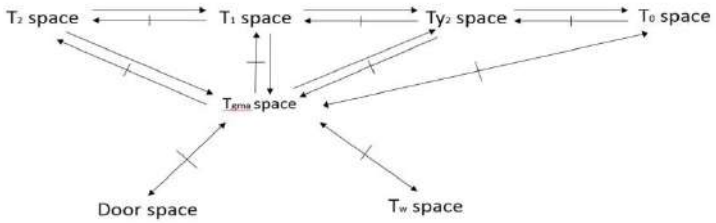
Remark 1.2.10 : The converse of the statement needn't be correct, as ascertained below.
Example 1.2.11 : i) Let Y={i_9, f_9, m_9} &η ={φ,{ i_9},{f_9, m_9},Y}
η- closed ={ φ,{ i_9},{f_9, m_9},Y }
Clearly Y is T $_{g\text{-}ma}$ space but not T_1 (T_2 resp.). Since f_9, $m_9 \in$ Y with $f_9 \neq m_9$ there does not exist any open set containing f_9 not m_9 or open set containing m_9 not f_9.

Remark 1.2.12 : T $_{g\text{-}ma}$ space is independent of T_ω space.
Example 1.2.13: i) Let Y={i_9, f_9, m_9} &η ={φ,{ i_9},{f_9, m_9},Y}
Open sets : φ,{ i_9},{f_9, m_9},Y
Closed sets :φ,{ i_9},{f_9, m_9},Y
ω-closed sets: φ,{i_9},{f_9},{m_9},{f_9, m_9},{i_9 ,f_9},{i_9, m_9},Y
g-m_a closed sets : φ,{i_9},{f_9},{m_9},{f_9, m_9}, Y
Clearly Y is T $_{g\text{-}ma}$ space but not T_ω space.
ii) Let Y={i_9, f_9, m_9, k_9, l_9} &
η ={ φ,{ i_9},{f_9},{k_9},{i_9,f_9},{f_9,k_9},{i_9,k_9},{i_9,f_9, k_9},Y}
Open sets: φ,{ i_9},{f_9},{k_9},{i_9,f_9},{f_9,k_9},{i_9,k_9},{i_9,f_9,k_9},Y}
Closed sets: φ,{m_9,l_9},{f_9,m_9,l_9},{i_9,m_9,l_9},{m_9,k_9,l_9},{i_9,f_9,m_9,l_9}, {i_1,m_1,k_9,l_9}, {f_9,m_9,k_9,l_9},Y
ω - closed sets: φ,{m_9,l_9},{f_9,m_9,l_9},{i_9,m_9,l_9},{m_9,k_9,l_9},{i_9,f_9,m_9,l_9}, {i_9,m_9,k_9,l_9}, {f_9,m_9,k_9,l_9},Y

g-m_a closed sets: φ
Clearly Y is T_ω space but not $T_{g\text{-}ma}$ space.

Remark 1.2.14: $T_{g\text{-}ma}$ space is independent of door space.
Example 1.2.15: i) Let Y={i_1, f_1, m_1} &η ={φ,{i_1},{f_1},{f_1,m_1},Y}.
Open sets : φ,{i_1},{f_1},{f_1,m_1},Y
Closed sets :φ,{m_1},{i_1, m_1},{f_1, m_1},Y
g-m_a closed set : φ
Clearly Y is door space but not $T_{g\text{-}ma}$ space.
ii) From example 1.2.13(i) Y is $T_{g\text{-}ma}$ space but not door space.

Remark 1.2.16 : From the above implications we have the following as given belo



1.3 g-ma Separation Axioms
g-m_a T_0 space, g-m_a T_1 space and g-m_a T_2 space, are introduced and characterized.

Definition 1.3.1:A topological space (Y,η) is g-m_a T_0 space if for any two points r_1 , t_1 of X, ∋ $r_1 \neq t_1$ then ∃ a g-m_i open set L ∋ $r_1 \in L$ & $t_1 \notin L$ or $r_1 \notin L$ & $t_1 \in L$.

Example 1.3.2: Let Y={i_9, f_9, m_9} &η ={φ ,{i_9},{f_9},{i_9,f_9},{i_9,m_9},Y}. Then (Y,η) is g-m_a T_0 space, since for points i_9, f_9 of Y ∋ $i_9 \neq f_9$, ∃ a g-m_i open set {f_9} ∋ $i_9 \notin \{f_9\}$ & $f_9 \in \{f_9\}$.

Theorem 1.3.3: Every subspace of g-m_a T_0 space is g-m_a T_0 space.
Proof : Consider (Y,η) be a g -m_a T_0&(W, η_W) be a subspace of (Y,η). Let r_1& t_1 be any points of W ∋ $r_1 \neq t_1$. As W is a subspace of Y , r_1& t_1 be any points of Y ∋ $r_1 \neq t_1$. Since Y is g-m_a T_0 space , then by definition 1.3.1 for points r_1, t_1 of Y ∋ $r_1 \neq t_1$ then ∃ a g-m_i open L ∋ $r_1 \in L$ & $t_1 \notin L$ or $r_1 \notin L$ & $t_1 \in L$. Then W∩L is a g-m_i open set in W ∋ $r_1 \notin W \cap L$ &$t_1 \in W \cap L$. Thus W is g-m_a T_0.

Theorem 1.3.4: If k : (Y,η)→ (W, τ)be g-m_i^* open map &(Y,η) be g-m_a T_0 space , then (W, τ)is g-m_a T_0 space.
Proof: Consider k to be a g-m_i^* open map & Y be g-m_a T_0 space. Let l_1 and l_2 be points of Y ∋ $l_1 \neq l_2$. As k is bijective map , ∃ h_1 and h_2 distinct points of Y ∋ k(h_1) = l_1 and k(h_2) = l_2. Since (Y,η) is g-m_a T_0 space , then by definition 1.3.1 then ∃ g-m_i open set E ∋ $h_1 \in E$ and $h_2 \notin E$. As k is g-m_i^* open map , k(E) is g-m_i open in W. Now we have
$h_1 \in E \Rightarrow k(h_1) \in k(E) \Rightarrow l_1 \in k(E)$ & $h_2 \notin E \Rightarrow k(h_2) \notin k(E) \Rightarrow l_2 \notin k(E)$. Thus for any two points l_1 and l_2 of W ∋ $l_1 \neq l_2$∃ a g-m_i open k (E) in W ∋ $l_1 \in k(E)$ & $l_2 \notin k(E)$. Therefore W is g-m_a T_0 space.

Theorem 1.3.5: A map k : (Y,η)→ (W, τ)is bijective g-m_a irresolute &(W, τ) is g-m_a T_0 space then (Y,η) is g-m_a T_0 space.

Proof: Consider k to be g-m_a irresolute map and (W, τ) be a g-m_a T_0 space. Let h_1 and h_2 be points of Y, $h_1 \neq h_2$. As k is bijective map then ∃ distinct points l_1 and l_2 in W ϶ $k(h_1) = l_1$ and $k(h_2) = l_2 \Rightarrow h_1 = k^{-1}(l_1)$ and $h_2 = k^{-1}(l_2)$. Since W is g-m_a T_0 space then by definition 1.3.1, ∃ a g-m_i open set E in W ϶ $l_1 \in E$ and $l_2 \notin E$. Also as k is g-m_a irresolute map , $k^{-1}(E)$ is g-m_i open set in Y. Now we have $l_1 \in E \Rightarrow k^{-1}(l_1) \in k^{-1}(E) \Rightarrow h_1 \in k^{-1}(E)$ and
$l_2 \notin E \Rightarrow k^{-1}(l_2) \notin k^{-1}(E) \Rightarrow h_2 \notin k^{-1}(E)$. Thus for points h_1& h_2 of Y, $h_1 \neq h_2$then ∃ a g-m_i open set $k^{-1}(E)$ in Y ϶ $h_1 \in k^{-1}(E)$ & $h_2 \notin k^{-1}(E)$. Therefore Y is g-m_a T_0 space.

Remark 1.3.6: g-m_a T_0 space is independent of T_0 space.

Example 1.3.7: Let Y={i_1,f_1 } &η ={φ ,{i_1},Y}. Then clearly Y is T_0 space but not g-m_a T_0 space. Since there does not exists any g-m_i open set L ϶ $i_1 \in L$ and $f_1 \notin L$ or $i_1 \notin L$ and $f_1 \in L$.

Example 1.3.8 Let Y={i_1, f_1, m_1} &η ={φ,{ i_1},{f_1, m_1},Y}
Open sets : φ,{ i_1},{f_1, m_1},Y
Closed sets :φ,{ i_1},{f_1, m_1},Y
g-m_a closed sets : φ,{i_1},{f_1},{m_1},{f_1, m_1}, Y
g-m_i open sets : φ,{i_1},{i_1, f_1},{i_1, m_1},{f_1, m_1}, Y
Clearly Y is g-m_a T_0 but not T_0 .

Definition 1.3.9: A topological space (Y, η) is g-m_a T_1 space if for any two points r_1& t_1 of Y, $r_1 \neq t_1$∃ a g-m_i open set E and L such that $r_1 \in E$, $t_1 \notin E$, & $r_1 \notin L$ & $t_1 \in L$.

Example 1.3.10: Let Y={i_1, f_1, m_1} &η ={φ,{ i_1},{f_1, m_1},Y} Then(Y, η) is g-m_a T_0 space, since for any point i_1, f_1 of Y, $i_1 \neq f_1$∃ a g-m_i open set {i_1} and {f_1, m_1} ϶ $i_1 \in \{i_1\}$, $f_1 \notin \{i_1\}$ and $i_1 \notin \{f_1, m_1\}$, $f_1 \in \{f_1, m_1\}$.

Theorem 1.3.11: If (Y, η) is g-m_a T_1 space, then (Y, η) is g-m_a T_0 space.
Proof : Consider l_1& l_2 to be points of Y ϶ $l_1 \neq l_2$. Since Y is g-m_a T_1 space, by definition 1.3.1 ∃ g-m_i open sets I & H ϶ $l_1 \in I$, $l_2 \notin I$, &$l_1 \notin H$, $l_2 \in H$. Thus we have $l_1 \in I$, $l_2 \notin H$. Hence (Y, η) is g-m_a T_0 space.

Remark 1.3.12: The converse of the statement needn't be correct, as ascertained below.

Example 1.3.13: Let Y={i_1, f_1, m_1} &η ={φ,{i_1},{i_1, m_1},{i_1, f_1},Y}. Let i_1 and m_1 be any two distinct points of Y . Let {i_1, f_1} be a g-m_i open ϶ $i_1 \in \{i_1, f_1\}$,$m_1 \notin \{i_1 , f_1\}$. Clearly (Y, η) is g-m_a T_0 space but not g-m_a T_1 space since there is no g-m_i open set I & H ϶ $i_1 \in I$, $f_1 \notin I$, and $i_1 \notin H$, $f_1 \in H$.

Theorem 1.3.14: Let k : (Y,η)→ (W, τ)be g-m_i^* open map & Y is g-m_a T_1 then W is g-m_a T_1 space.
Proof : Let b_1 ,b_2 be any two distinct points of Y . As k is g-m_i^* open map it is bijective map , hence ∃ distinct points a_1 ,a_2 of Y ϶ $k(a_1) = b_1$ and $k(a_2) = b_2$. Since (Y,η) is g-m_a T_1 space then by definition 1.3.9 , ∃ g-m_i open I & H in (Y,η) ϶ $a_1 \in I$, $a_2 \notin I$, & $a_1 \notin H$, $a_2 \in H$. Since k is g-m_i^* open map k(I) & k(H) are g-m_i open set in W. Now we have
$a_1 \in I \Rightarrow k(a_1) \in k(I) \Rightarrow b_1 \in k(I)$, $a_2 \notin I \Rightarrow k(a_2) \notin k(I) \Rightarrow b_2 \notin k(I)$ &
$a_1 \notin H \Rightarrow k(a_1) \notin k(H) \Rightarrow b_1 \notin k(H)$, $a_2 \in H \Rightarrow k(a_2) \in k(H) \Rightarrow b_2 \in k(H)$. Thus for any two points b_1 and b_2 such that $b_1 \neq b_2$ of W ∃ a g-m_i open k(I) and k(H) in W ϶ $b_1 \in k(I)$ and $b_2 \notin k(I)$ and $b_1 \in k(H)$ & $b_2 \notin k(H)$.Therefore W is g-m_a T_1 space.

Theorem 1.3.15: Amap k : (Y,η)→ (W, τ) is bijective g-m_a irresolute map &W is g-m_a T_1 then Y is g-m_a T_1 space.

Proof: Consider k to be bijective g-m_a irresolute map and W be g-m_a T_1 space. Let a_4 and a_5 be points of Y, $a_4 \neq a_5$. As k is bijective map, ∃distinct points b_4& b_5 in W ∋ $k(a_4) = b_4$ and $k(a_5) = b_5 \Rightarrow a_4 = k^{-1}(b_4)$ and $a_5 = k^{-1}(b_5)$. Since W is g-m_a T_1 space then by definition 1.3.9 ∃ a g-m_i open sets I & H in W ∋ $b_4 \in I$, $b_5 \notin I$ & $b_4 \notin H$, $b_5 \in H$. Also since k is g-m_a irresolute map , $k^{-1}(I)$ & $k^{-1}(H)$ are g-m_i open sets in Y. Now we have $b_4 \in I \Rightarrow k^{-1}(b_4) \in k^{-1}(I) \Rightarrow a_4 \in k^{-1}(I)$, $b_5 \notin I \Rightarrow k^{-1}(b_5) \notin k^{-1}(I) \Rightarrow a_5 \notin k^{-1}(I)$ and $b_4 \notin H \Rightarrow k^{-1}(b_4) \notin k^{-1}(H) \Rightarrow a_4 \notin k^{-1}(H)$, $b_5 \in H \Rightarrow k^{-1}(b_5) \in k^{-1}(H) \Rightarrow a_5 \in k^{-1}(H)$. Thus for points a_4 and a_5 of Y , $a_4 \neq a_5$ ∃ g-m_i open sets $k^{-1}(I)$ and $k^{-1}(H)$ in Y ∋ $a_4 \in k^{-1}(I)$, $a_5 \notin k^{-1}(I)$ and $a_4 \notin k^{-1}(H)$, $a_5 \in k^{-1}(H)$. Therefore Y is g-m_a T_1.

Definition 1.3.16: A topological space (Y,η) is g-m_a T_2defined as ,if for any two points r_1& t_1 of Y, ∋ $r_1 \neq t_1$∃ g-m_i open sets Q & D ∋$r_1 \in Q$, $t_1 \in D$ & $Q \cap D = \phi$.

Example 1.3.17: Let $Y=\{i_1, f_1, m_1\}$ &$\eta = \{\varphi, \{i_1\}, \{f_1, m_1\}, Y\}$. Then (Y,η) is g-m_a T_2 space, since for points i_1, f_1 of Y, $i_1 \neq f_1$∃ g-m_i open set $\{i_1\}$ and $\{f_1, m_1\}$ such that $i_1 \in \{i_1\}$, $f_1 \in \{f_1, m_1\}$and $\{i_1\} \cap \{f_1, m_1\} = \phi$.

Theorem 1.3.18: Every g-m_a T_2 space is g-m_a T_1 space.
Proof : Consider r_1& t_1 to be points of Y ∋ $r_1 \neq t_1$. As (Y,η) is g-m_a T_2 space, then by definition 1.3.16 , ∃g-m_i open sets Q and D , $Q \cap D = \phi$∋$r_1 \in Q$, $t_1 \in D$, this implies $r_1 \in Q$, $t_1 \notin Q$ and $r_1 \notin D$, $t_1 \in D$. Therefore Y is g-m_a T_1 space.

Remark 1.3.19: The converse of the statement needn't be correct, as ascertained below.

Example 1.3.20: i) Let $Y=\{i_9, f_9, m_9\}$ &$\eta = \{\varphi, \{i_9\}, \{m_9\}, \{i_9, m_9\}, \{f_9, m_9\}, Y\}$.
Then (Y,η) is g-m_a T_1 space. Since i_9, f_9 of Y, $i_9 \neq f_9$∃ g-m_i open set open set $\{i_9, m_9\}$ and $\{f_9, m_9\}$ ∋$i_9 \in \{i_9, m_9\}$, $f_9 \notin \{i_9, m_9\}$ and $i_9 \notin \{f_9, m_9\}$, $m_9 \in \{f_9, m_9\}$, but Y is not g-m_a T_2 space since $\{i_9, m_9\} \cap \{f_9, m_1\} \neq \phi$.

Theorem 1.3.21: A map $k : (Y,\eta) \rightarrow (W, \tau)$ be g-m_i^* open and Y be g-m_a T_2 space then W is g-m_a T_2 space.
Proof : Consider b_1 ,b_2 to be any two points of Y such that $b_1 \neq b_2$. As k is g-m_i^* open it is bijective map , ∃ distinct points a_1 ,a_2 of Y ∋ $h(a_1) = b_1$ and $h(a_2) = b_2$. Since (Y,η) is g-m_a T_2 space then by definition 1.3.16 , ∃ g-m_i open sets I & H in Y, $I \cap H = \phi$∋$a_1 \in I$, $a_2 \in H$. Since k is g-m_i^* open map k (I) and k(H) are g-m_i open set in W also $k(I) \cap k(H) = \phi$. Now we have $a_1 \in I \Rightarrow k(a_1) \in k(I) \Rightarrow b_1 \in k(I)$, $a_2 \in H \Rightarrow k(a_2) \in k(H) \Rightarrow b_2 \in k(H)$ and $k(I) \cap k(H) = \phi$. Thus for any two points b_1 and b_2 of W ∋ $b_1 \neq b_2$, ∃ a g-m_i open sets k(I) and k(H) in W ∋$b_1 \in k(I)$and $b_2 \in k(H)$ &$k(I) \cap k(H) = \phi$. Hence W is g-m_a T_2 space.

Theorem 1.3.22:A map $k : (Y,\eta) \rightarrow (W, \tau)$ be bijective g- m_a irresolute & W is g- m_a T_2 space, Y is g- m_a T_2 space.
Proof: Consider k to be bijective g-m_a irresolute map & W be g-m_a T_2 space. Consider a_1& a_2 be points of Y, $a_1 \neq a_2$. Since k is a bijective map ∃ distinct points b_1 and b_2 in W ∋$k(a_1) = b_1$& $k(a_2) = b_2 \Rightarrow a_1 = k^{-1}(b_1)$ & $a_2 = k^{-1}(b_2)$. Since W is g-m_a T_2 space then by definition 1.3.16 ∃ g-m_i open sets I & H in W, $I \cap H = \phi$∋$b_1 \in I$, $b_2 \in H$. Also since k is g-m_a irresolute map , $k^{-1}(I)$ & $k^{-1}(H)$ are g-m_i open sets in Y and $k^{-1}(I) \cap k^{-1}(H) = \phi$. Now we have $b_1 \in I \Rightarrow k^{-1}(b_1) \in k^{-1}(I) \Rightarrow a_1 \in k^{-1}(I)$, $b_2 \in H \Rightarrow k^{-1}(b_2) \in k^{-1}(H) \Rightarrow a_2 \in k^{-1}(H)$ &$k^{-1}(I) \cap k^{-1}(H) = \phi$. Thus for any two points a_1 and a_2 of Y ∋ $a_1 \neq a_2$, ∃ g-m_i open sets $k^{-1}(I)$ & $k^{-1}(H)$ in Y ∋$a_1 \in k^{-1}(I)$, $a_2 \in k^{-1}(H)$ & $k^{-1}(I) \cap k^{-1}(H) = \phi$. Therefore Y is g-$m_a$ T_2 space.

Theorem 1.3.23: Let (Y,η) be a topological space , then Y is g-m_a T_2 space iff the intersection of each g-m_a neighborhood of each point Y is a singleton .

Proof : Let Y be g-m_a T_2-space . Let a_1 and a_2 be points of Y ∋ $a_1 \neq a_2$. Since (Y,η) is g-$m_a$$T_2$-space , then by definition 1.3.16 ∃ g-m_i open sets M & D ∋ $a_1 \in M$, $a_2 \in D$ & $M \cap D = \phi$ .Since $M \cap D = \phi \Rightarrow a_1 \in M \subseteq Y - D$. Since D is g-m_i open ,Y- D is g-m_a closed . So Y- D is g-m_a neighborhood of a_1, since a_2 is arbitrary. We have the intersection of all g-m_a neighborhood of a_1 is singleton $\{a_1\}$.
Conversely, let $\{a_1\}$ be the intersection of all g-m_a neighborhood of an arbitrary point $a_1 \in Y$. Let a_2 be any point of Y other than a_1.As a_2 does not belong to the intersection of all g-m_a neighborhood, there exist a g-m_a neighborhood of a_1

such that $a_2 \notin N$. Since N is g-m_a neighborhood of a_1, ∃ a g-m_i open Q ∋$a_1 \in Q \subseteq N$. Thus Q & Y- N are g-m_i open sets ∋ $a_1 \in Q$, $a_2 \in Y- N$ & $Q \cap Y -N = \phi$. Hence Y is g-m_a T_2 space.

Theorem 1.3.24: A maping k : $(Y,\eta) \rightarrow (W, \tau)$ & h : $(W, \tau) \rightarrow (H,\sigma)$ are generalized maximal irresolute & (W, τ) is g-m_a T_2 space then h o k: $(Y,\eta) \rightarrow (H,\sigma)$ is generalized maximal irresolute.

Proof: The proof is omitted as it is obvious from the result that If a map k : $(Y,\eta) \rightarrow (W, \tau)$ is a generalized maximal irresolute and h : $(W, \tau) \rightarrow (H,\sigma)$ is a generalized maximal irresolute, then h o k: $(Y,\eta) \rightarrow (H,\sigma)$ is generalized maximal irresolute.

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RESEARCH ARTICLE

Smart Automation Agriculture using IoT Technologies

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ABSTRACT

Agriculture is the primary occupation in our country for ages. The Indian economy is heavily dependent on agriculture and the livelihood of the Indian famer largely depends on the Monsoon rains. Moreover water is essential nutrients to fertilizer roots so to overcome these problem, we go for smart agriculture techniques using IoT. This research article includes various features like GPS based remote controlled monitoring, moisture & temperature sensing, intruders scaring, security, leaf wetness and proper irrigation facilities. It makes use of wireless sensor networks for noting the soil properties and environmental factors continuously. Various sensor nodes are deployed at different locations in the farm. Controlling these parameters are through any remote device or internet services and the operations are performed by interfacing sensors, Wi-Fi, camera with microcontroller. This concept is created as a product and given to the farmer's welfare. And this research article focus on agriculture growth, agriculture is very important sector of the Indian economy. Because of agriculture growth drastically increase Indian economic growth also.

Keywords: IoT, Sensors, GPS, Microcontroller, Wi-Fi

INTRODUCTION TO SMART AGRICULTURE

As the world is trending into new technologies and implementations it is a necessary goal to trend up in agriculture also. Many researches are done in the field of agriculture. Most projects signify the use of wireless sensor network collect data from different sensors deployed at various nodes and send it through the wireless protocol. The collected data provide the information about the various environmental factors. Monitoring the environmental factors is not the complete solution to increase the yield of crops. There are number of other factors that decrease the productivity to a greater extent. Hence automation must be implemented in agriculture to overcome these problems [1]. So, in

order to provide solution to all such problems, it is necessary to develop an integrated system which will take care of all factors affecting the productivity in every stage. But complete automation in agriculture is not achieved due to various issues. Though it is implemented in the research level it is not given to the farmers as a product to get benefitted from the resources. Hence this research article deals about developing smart agriculture using IoT and given to the farmers.

LITERATURE SURVEY

The existing method and one of the oldest ways in agriculture is the manual method of checking the parameters. In this method the farmers they themselves verify all the parameters and calculate the readings [1]. It focuses on developing devices and tools to manage, display and alert the users using the advantages of a wireless sensor network system [2]. It aims at making agriculture smart using automation and IoT technologies. The highlighting features are smart GPS based remote controlled robot to perform tasks like weeding, spraying, moisture sensing, human detection and keeping vigilance [3]. The cloud computing devices that can create a whole computing system from sensors to tools that observe data from agricultural field images and from human actors on the ground and accurately feed the data into the repositories along with the location as GPS coordinates [4]. This idea proposes a novel methodology for smart farming by linking a smart sensing system and smart irrigator system through wireless communication technology.[5]It proposes a low cost and efficient wireless sensor network technique to acquire the soil moisture and temperature from various location of farm and as per the need of crop controller to take the decision whether the irrigation is enabled or not.[6]It proposes an idea about how automated irrigation system was developed to optimize water use for agricultural crops. In addition, a gateway unit handles sensor information..

INTERNET OF TECHNOLOGY

Geek tum and technology is poised for a huge leap forward in its name the IOT [2], Internet has been around for a while but it's been mostly the product of people so all the data and images and recordings and games book and commerce and all of that was created by people for people and about people. The internet is one the most important and transformative technologies ever invented [3], I happen to know a few people who couldn't live without it all. Internet is like a digital fabric that's woven into the lives of all of us in one way or another the internet of people change the world well there's a new internet emerging and it's poised to change the world again you see this new internet is not just about connecting people it's connecting about things. So it's named the Internet of things. Connecting the thing is the big deal in the Internet. Things start to share their experiences with other things, that's how works IOT [4]. Take things and then you add the ability to sense and communicate and touch and control and there you get an opportunity for things to interact and collaborate with other things

People are still working on different Smart Farming technology using IoT, so the anticipated benefits of this technology are, Remote monitoring for farmers, water and other natural resource conservation, good management also allows improved livestock farming, the things which are not visible to necked eye can be seen subsequent is accurate farmland and crop evaluation, good quality as well as improved quantity, the facility to get the real- time data for useful insights.

SHORTFALLS OF SMART FARMING

- Agriculture being a natural phenomenon relies mostly on nature, and man predict or control nature let it be rain drought sunlight availability. Pests control etc[5]. So ever implementation IoT system agriculture.
- The smart agriculture need availability on internet continuously. Rural part of the developing countries did not fulfil this requirement. Moreover, internet is slower.
- Fault sensor or data processing engines can cause faulty l decisions which may lead to over use of water, fertilizers and other wastage of resources.
- The smart farming-based equipment require farmer to understand and learn the use of technology. This is the major challenge in adopting smart agriculture framing at large scale across the continues

PROPOSED WORK

In the field section, various sensors are deployed in the field like temperature sensor, moisture sensor and PIR sensor [6]. The data collected from these sensors are connected to the microcontroller through RS232. In control section, the received data is verified with the threshold values. If the data exceeds the threshold value the buzzer is switched ON and the LED starts to blink. This alarm is sent as a message to the farmer and automatically the power is switched OFF after sensing [7]. The values are generated in the web page and the farmer gets the detailed description of the values. In manual mode, the user has to switch ON and OFF the microcontroller by pressing the button in the Android Application developed. This is done with the help of GSM Module. In automatic mode, the microcontroller gets switched ON and OFF automatically if the value exceeds the threshold point. Soon after the microcontroller is started, automatically an alert must be sent to the user. This is achieved by sending a message to the user through the GSM module. Other parameters like the temperature, humidity, moisture and the PIR sensors shows the threshold value and the water level sensor is used just to indicate the level of water inside a tank or the water resource [9].

HARDWARE USED

1. Arduino
2. Solid sensor
3. Humidity Sensor
4. Relay
5. Temperature sensor.

SOFTWARE USED

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online [10]. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based onWirinig), and the Arduino Software(IDE), based on Processing. Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike.

Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming [11]. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments. Basically takes the sensor date which are provided by these three sensors, first is the temperature second is the soil moisture, third is the ph and this sensor gives the data to the Arduinouno and this data is then being transferred to the raspberry pi soc using a serial communication protocol, which is the UART the sensor data [12] are also used for the actuator that is being installed by this first system which in this case is the water pump now water pump is used regulate the flow of water to the crops which could enable effective use in the amount of water. Secondly now comes the two cameras that are being installed in the raspberry pi both the cameras give the information about the vegetation information as well as the disease detection system, after processing all this type all these systems the raspberry pi is acting as the gateway to provide this information to a cloud database which in this case in the google firebase, from the google firebase the information can be accessed through the user mobile applications, that we have designed [13].

ALGORITHM OF PARAMETER MEASUREMENT SYSTEM

Step 1: start
Step 2: initialized LCD display and GSM
Step 3: water level measurement also temperature, humidity is sensed.

Step4: soil moisture is sensed

Algorithm of measurement for level of water in tank
Step 1:- start
Step 2:- level of water in tank is sensed
Step 3:- If water level is low then motor is ON

Algorithm of automatic dripping and sprinkler the water
Step 1:- Start
Step 2:- Temperature and humidity sensor
Step 3:- It decides dripping of water or sprinkle the water

Algorithm of automatic dripping of fertilizer
Step 1:- start
Step 2:- Ph value is sensed
Step 3:- According to ph value it decides fertilizer is to be used
Step 4:- Drip the Water

IMPLEMENTATION
Our aim was to create a prototype model, which can be easily installable in the field and is also easy to use as farmers might not have the technical knowledge. With the use of IoT the system is automated. As you can see, it is the inside view of the prototype model where all the sensors and ESP32s are connected via breadboard and the power bank is used for power supply. (b), the outside view of the model with LEDs and in (c) we have put a snapshot which is showing humidity and temperature. In the same way we can have different windows to monitor live feed from different sensors, create graphs for further analysis as well. 1) We used ESP32s node MCU, which is wireless and Wi-Fi enable. 2) On breadboard, we connected the ESP and DHT11 temperature and humidity sensor, soil moisture sensor, buzzer, LEDs and SI1145 Digital UV Index / IR / Visible Light Sensor with the help of jumper wires.

ESP32 goes to sleep after every 18 minutes, wakes up, takes the reading, upload it on the Blynk app cloud to feed the live data and goes to sleep mode again. 4) The LEDs retain the state so when the farmer passes through if he didn't hear the sound or got the notification on phone can look the LEDs to take the necessary steps. Where turning red, blue or violet will give different indications. Same as one buzzer sound signals something, two means something else. 5) In the prototype model, bucket is used. Here the soil moisture sensor is fitted at the bottom and temperature humidity sensor, Digital UV Index sensor and the buzzer are placed at the top by putting a whole in the cover. 6) We give power with the help of a 6000 mAh power bank, so after uploading the code the system works on itself. The sleep mode also helps to save power to increase the life of the power bank. So, what difference does it make in terms of total duration? To see that we will need power consumption for every component used in the prototype. The details about every component is as follows, We are using ESP32, which has a power pin of 3.3V as well as 5V, here we connect sensors to 5V pin and the max operating voltage of the sensors are 5V.

CONCLUSION

This article presents a performance evaluation of the smart agriculture. First, we have presented some conclusions that have emanated from the state of the art. We also proposed and validated a mathematical model for accurately estimating the successful transmission of the input and output of the data and the information about the soil. Which is a pilot farm based on the transmission interval and the number of nodes. This model assesses the compromise between the number of nodes and the transmission interval on the successful packet delivery rate. This result will

help developers during the first stages of analysis and design and allow them to adequately choose the parameters to obtain a good performance.

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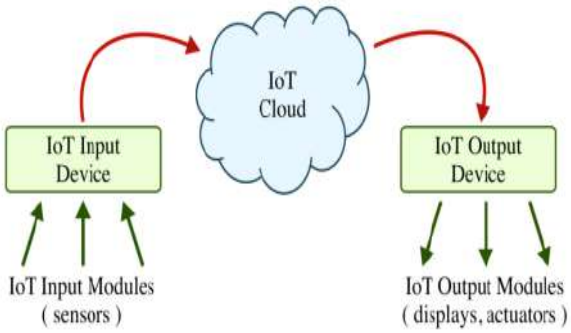

Figure 1. IoT Cloud diagram

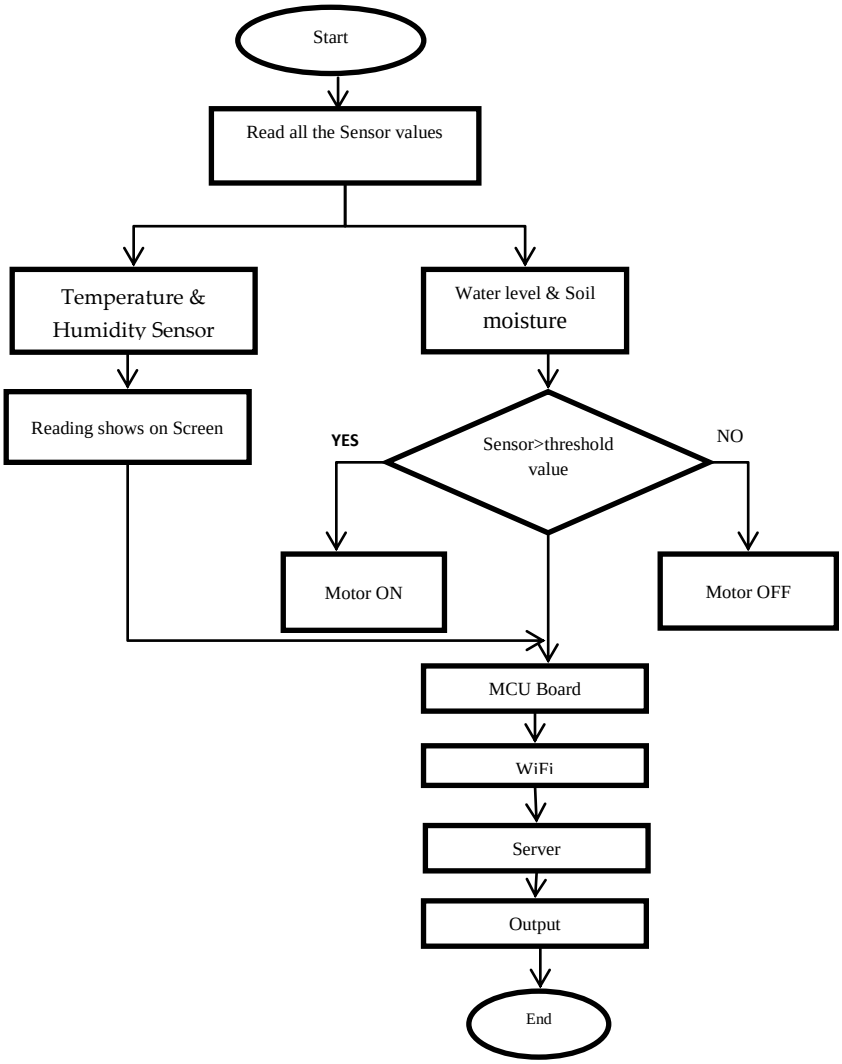

Figure 2. Procedure of Algorithm

Figure-3 Module of IoT

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RESEARCH ARTICLE

Curvelet Transform and Image Feature Based Copy-Move Forgery Image Source Identification

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ABSTRACT

With the increasing popularity of electronic gadgets, image capturing is very simple and convenient mannerly done by any person. Because image performs a major role in the most job. With the availability of image editing's software like Adobe Photoshop and CorelDraw, the portions of the image or entire image can be modified without any obvious sign. This leads to discarding image authenticity. These modifications are not visible to the naked eye. Copy move forgery is a common image manipulations operation. The copy-move forgery can be performed within the same image or another image. During image capturing every region of the image is stored with its unique features. Many researchers have already been carried out on copy-move forgery detection. In this paper, we propose a method to detect copy-move forgery detection based on curvelet transform.

Keywords: Image Source, Copy-Move, Image Features, Curvelet Transform.

INTRODUCTION

In the digital world, every day highly performed digital devices; camera and mobiles are coming to market. Also, due to the advancement of digital image processing softwares and tools, the image can be easily edited and manipulated. These modifications are not visible to the naked eye. Forgery is not new to the world [1]. In ancient days it was limited to art and literature but did not affect any human life. Nowadays, digital images are a major source, which covers newspapers, cover image of magazine, proof of court evidence [2]. Digital Image forgery is classified into two ways like active and passive. In which, the passive approach is also classified into four categories like Pixel based forgery, Format based forgery, Source device based forgery, and geometry based techniques[1].Copy move forgery is pixel based technique. This type of forgery can be done by any person very easily either in the same image or other

images [3]. Researchers have proposed many techniques to detect image forgery.
This paper is organized as follows: Overview of different methods of detecting copy move forgery detection of research method in section 2, section 3 illustrate the proposed method of copy move forgery using curvelet transform, experiment results are discussed in section 4, section 5 concludes this paper.

RESEARCH METHOD

In the internet world, Copy move forgery is very common, until it does not affect any human. I. T. Ahmed et al [4] proposed a method to detect the copy move forgery using spatial feature domain, in which the edge features could not be detected perfectly. L. Kang et al [5] proposed a technique to detect the forgery with the help of block matching features. Rodriguez-Ortega et al [6] proposed two approaches that use deep learning a model using custom architecture and another. model with transfer learning. The depth of the network is analyzed in each approach. AKPCA with sift based forgery detection proposed by Jeyalakshmi et al [7]. In which the region of tampering is detected with two step approaches.

Curvelet transform

curvelet transform is powerful tool for Image denoising , feature extraction in digital images. Traditional wavelet transforms are not able to represent the edge discontinuities along the curves perfectly. To overcome this negative aspect, researchers simply use curvelet transform to represent the two dimensional singularities along the curves..Hence curvelets will be superior to wavelets [9].This is a multiscale directional transform that allows an almost optimal nonadaptive sparse representation of objects with edges. The curvelet transform of function f can be represented by,

$c(j,l,k) := < f \quad \varphi_{j,l,k} > \quad (1)$

Where $\varphi_{j,l,k}$ is the curvelet, j,l,k is scale, direction and position parameter respectively[8]. The digital curvelet transform is defined by

$c^D(j,l,k) := \sum_{0 \le t1,t2 < n} f[t1,t2]\overline{\varphi^D_{j,l,k}[t1,t2]}(2)$

The figure 1 represents the edge singularities of wavelet and curvelet approximations. The curvelet requires least number of coefficients to compute the edge features along with curves.

Copy Move Forgery Detection

Every day millions of digital images are captured or generated by various digital devices; which are also easily modified by different multimedia software's. Hence, Digital image Copy-Move process is not a new thing. This process is good, until it does not affected any human or living things. In this proposed method the copy move forgery has been detected by curve let transform. Initially, the source image has been divided into four level of sub band like LH, HL, HH and LL. Discrete Curvelet transform is applied on LH, HL, and HH sub band and extract features from high resolution coefficients. The extracted features have been arranged in lexicographical order. This is also known as dictionary order. Block based classification is performed on one another. The mismatched features region is marked by different color.

GLCM Features

Gray **L**evel **C**oocurrence **M**atrix method is a way of extracting second order statistical features.
Energy: This is second moment in GLCM. High energy values occur when the gray level distribution has a constant or periodic form. Energy has a normalized range
Entropy: This measures the disorder or complexity of an image. The entropy is large when the image is not texturally uniform and many GLCM elements have very small values.
Variance: This is a measure of heterogeneity and is strongly correlated to first order statistical variable such as standard deviation. Variance increases when the gray level values differ from their mean.

Homogeneity: This is also called as Inverse Difference Moment. It measures image homogeneity, It is more sensitive to the presence of
near diagonal elements in the GLCM.
Correlation: This feature is a measure of gray tone linear dependencies in the image.

Support Vector Machine (SVM)
Support Vector Machine (SVM) is a famous classification tool in image processing and pattern recognition [10]. , which has been widely used in supervised learning techniques. SVMs are based on the idea of minimizing training set error by constructing a hyper plane as the decision surface in such a way that the margin of separation between different classes are maximized. Consider a two-class classification problem with linearly separable data and training feature sets [mi, yi] (i =1,… K), where yi is the label of the feature vector mi with a value of either +1 or -1. The feature vector m lies on a hyper plane given by wT.m+b=0 where w is the normal to the hyper plane.

Algorithm of calculating GLCM Features:

1. Quantize the image data.
   Each sample on the echogram is treated as a single image pixel and the value of the sample is the intensity of that pixel
2. Create the GLCM Matrix
3. Calculate the statistical features
4. Sample S in the resulting variable is replaced by the value of this calculated feature.

Algorithm for Copy-Move Forgery Detection

1. Get the Source Image f(x,y)
2. Divide the image into four subband HH,LL,HL,LH
3. Apply the Discrete curvelet transform

$$c^D(j,l,k) := \sum_{0 \le t1,t2 < n} f[t1,t2]\overline{\varphi^D_{j,l,k}[t1,t2]}$$

4. Extract the GLCM Features from the Sub band HH,HL,LH
5. Sort the extracted features in lexicographical order(Dictionary)
6. Classify the extracted features.
7. Spot out the uneven region as forgery.

EXPERIMENTS AND RESULTS

In the Experiment and testing image data base has been download from CoMoFoD - Image Database for Copy-Move Forgery Detection[11]. More than 200 sample pre-processed images are available in this CoMoFoD database. In this paper nearly 10 images have been used for experiment. Extract the GLCM features using discrete wavelet and curvelet transform. Based on the simulation result, the curvelet transform returns much better outcome than wavelet transform. Table 1tabulate the extracted Features of digital image using wavelet and curvelet transform define in the form of precision and recall rate. Figure 3.a and 3.b are original and copy move forgery image; which are downloaded from CoMoFoD database. These are standard testing image for copy-move forgery process.Figure3.c is the curvelet based copy-move forgery detected image. Figure 4 describes the copy-move forgery detection based on precision and recall rate in percentage wise. With the simulation results and graphical representation; the curvelet transform performance rate is better than traditional discrete wavelet transform, because the edge discountinuties along with curves representation are absolutely computed than traditional wavelet transform.

CONCLUSION

For Copy-Move forgery detection, many real-world applications are existing in the market. However, they are providing some static solution. Most of the methods are used to point out the forgery region only. They could not be detected the edge discontinuities along with curves. Nowadays, curve let transform performs to detect the edge features along with curves perfectly. In this paper, the proposed method implemented with curve let transform based copy–move forgery detection. The simulation results via; the proposed method gives better performance than traditional wavelet transform.

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Table 1: Simulation Results of Copy- Move Forgery Detection using wavelet and curvelet transform

Methods	No. of Images Detected as forged out of 10 Images				Precision(p)	Recall(r)
	T_P	T_N	F_P	F_N		
Discrete Wavelet	8	7	5	4	61.5%	66.6%
Curvelet wavelet	9	6	2	1	81.8%	90%

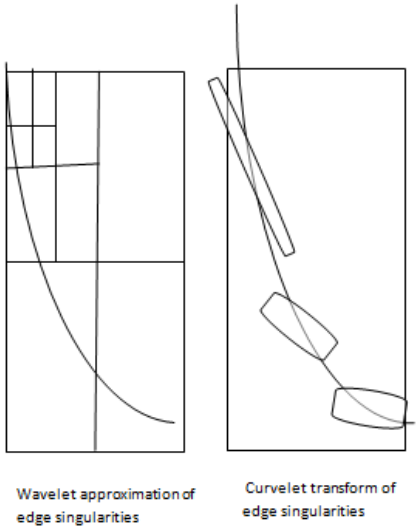

Fig:1 Curvelet transform

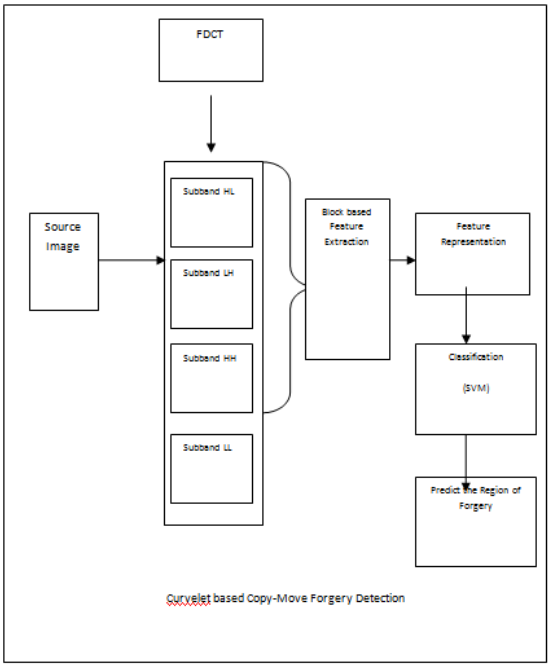

Fig: 2 proposed method of CM Forgery Detection

Fig 3 a Original Image

3.bForgery Image

3.c Copy- Move Detected

Fig 3 a Original Image

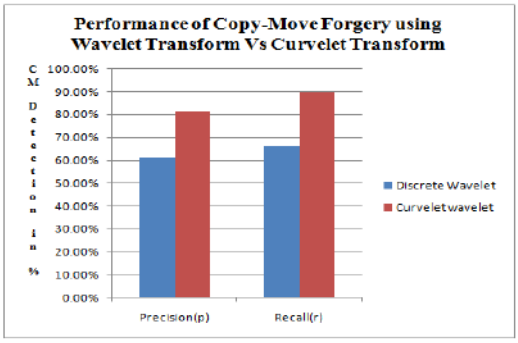

Fig 4: Performance of CM Detection Rate

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RESEARCH ARTICLE

Squeeze Film Lubrication between Secant Rough Curved Circular Plates: Effects of Surface Roughness and Micropolar Fluids

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ABSTRACT

Using Eringen's Micro-continuum model and Christensen's stochastic theories, the non-Newtonian effects of roughness together with rheology of a surface at the absolute properties about secant rough curved circular plates have been studied. A modified Reynolds equation was used to account for the nature of micro-continuum model of Eringen, stochastic theories of Christensen and was solved by the quadrature formula. This method is the most effective in minimizing errors and achieving an exact solution. Based on findings Factors like azimuthal roughness enhance the distribution of pressure, capacity to carry the load and the time of response to squeezing the film associated to micro polar fluids lubricate the smooth surface. However, the effects of radial roughness result in an opposite trend. Rough surfaces and non-Newtonian fluids can have a big impact on the performance of circular plates with curvature are greater with bigger values of the interaction parameter, the roughness parameter as well as coupling parameter. The extensive analysis presented here highlights some of the most important properties of bearing characteristics that can be used to pick appropriate design settings.

Keywords: Surface roughness; Secant curved circular plates; Micro polar fluids.

INTRODUCTION

Murti[1] introduced films are squeezed into circular curved plates. It demonstrates the curved film generated between the two plates is described by an exponential function. Makes it simpler to resolve the problem that the time needed to attain a specified reduction in the thickness of the film formed between two plates is expressed in terms of the length of time needed to achieve the precise reduction in the thickness of the film on flat plates. Micro-polar fluids are composed of particles that have individual motion. Eringen [2] created the micro-polar theory as a special micro-fluid case that includes local inertia rotators, couple stress, and inertial spin. Using this theory Naduvinamani and Patil[3] in their finite exponential analysis of the static and dynamic properties of slider bearings. It has been noticed that the exponentially-shaped slider bearings that are lubricated using micro polar fluids have higher stable-state films pressures, capacity to carry the load, as well as better static stiffness, damping and dynamic capabilities. Kucaba[4]was examined to determine squeeze flow simulation. Determined the extreme width was among the plates, where the properties of micro polar fluid are important. The topographical conditions that are discovered in industrially and technologically systems of relevant flow ranging from internal flow (oil gas and channels as well as synovial fluid within cartilage articular) and external flow (bearing systems with turbine blades in automotive engineering ships hulls and wind turbines) may affect working of the system over a period. various destructive mechanisms like the usage of excessively or defilement of the fluids utilized in the system cause this degradation. This destruction to the surface forms surface severities, also known as roughness of the surface, and has various heights, and consequently, affecting the system performance. Because these idealized features of roughness on the surface are not easily understood as well as because of the variety of topographic scales for roughness, a thorough knowledge of in what manner roughness of the surface affects the bearings efficiency are essential. Other factors affect the performance of bearings. This is why the rough surface theory have been researched in recent years with great interest. This is why it is crucial to study the physical aspects that relate to roughness on surfaces of the bearing. An effect of roughness on functioning of the actual classifications isn't completely understood, but certain studies suggest that roughness has a significant impact on the structural characteristics in the flow. Christensen[5]elaborated the stochastic model of rough surface with hydrodynamic lubrication. Using this concept Bujurkeet al.[6]demonstrated the squeezing film between curving annular plates being lubricated. The outcome of radial (circumferential) roughness is observed that it shifts the pressure point toward that of the intake (outlet) edge. We also note that the capacity to carryload grows (decreases) in those who have the roughness patterns on the circumference (radial), associated with a smooth counterpart that is for concave and convex pads. Andharia and Pandya[7]examined the impact of the roughness of the surface along the longitudinal direction in the operation of Rayleigh step bearings. The conclusion is that the capacity of the bearing is increased when the value increases for standard deviation. The effects of roughness on surfaces and micro polar fluids have been examined by various authors [8-17] during their research on various bearing systems, like inclined slider bearings, rectangular plates, long parallel plates as well as parallel circular plates, short journal bearings, longer journal bearings, anisotropic poroelastic rectangle plates, wide-plane sliding bearings, journal bearings during steady-state and the transient EHL movement of circular contact with squeeze respectively. Furthermore, researchers [18-24] also contributed their research on surface roughness by using various non-Newtonian models of fluids. Roughness of the surfaces and fluid micro polarity impacts between secant rough curving circular plates, lubricating of squeeze films is investigated in this paper. The study makes use of radial and azimuthal roughness patterns.

Analysis and the Problem's Solution

As seen in Figure 1, the composition of the film with the squeeze formed between the two-secant curved circular plates, where a higher plate moves closer to a lower plate at a velocity of V $\left(= dh_m / dt\right)$.

Film Thickness is defined by:

The relationship determines the upper plate that runs on the surface

$$z_u = h_m \sec(\beta r^2); \qquad 0 \le r \le a \tag{i}$$

The lower plate that runs on the surface as determined by the relationship

$$z_l = h_m \left\{\sec(\alpha r^2) - 1\right\};\ 0 \le r \le a \quad \text{(ii)}$$

h_m is the centre thickness of the film, and β as well as α are the parameters for the curvature of associated plates.

As a result, $h(r)$ is the film thickness given by

$$h(r) = h_m \left\{\sec(\beta r^2) - \sec(\alpha r^2) + 1\right\};\quad 0 \le r \le a \quad \text{(iii)}$$

Basic equations of motion are

$$\left(\mu + \frac{\chi}{2}\right)\frac{\partial^2 u}{\partial z^2} + \chi\frac{\partial w_1}{\partial z} = \frac{\partial p}{\partial r} \quad \text{(iv)}$$

$$\gamma\frac{\partial^2 w_1}{\partial z^2} - \chi\frac{\partial u}{\partial z} - 2\chi w_1 = 0 \quad \text{(v)}$$

Following is the continuity equation

$$\frac{\partial w}{\partial z} + \frac{1}{r}\frac{\partial}{\partial r}(ru) = 0 \quad \text{(vi)}$$

Following are the boundary conditions:

At $z = h$ (higher surface), $u = 0,\ w_1 = 0,\ w = \frac{dh_m}{dt}$ (vii)

At $z = 0$ (lower surface), $u = 0,\ w_1 = 0,\ w = 0$ (viii)

The solutions to equations (4) and (5) with boundary conditions (7) and (8) are

$$u = \frac{p'}{\mu}\left[\frac{z^2}{2} - \frac{N^2 h}{m}\frac{(Coshmz - 1)}{Sinhmh}\right] + \frac{D_1}{(1 - N^2)}\left\{z - \frac{N^2}{m}\left[Sinhmz - (Coshmz - 1)\frac{(Coshmh - 1)}{Sinhmh}\right]\right\} \quad \text{(ix)}$$

and $$w_1 = \frac{D_1}{2(1 - N^2)}(Coshmz - 1) + \frac{Sinhmz}{Sinhmh}\left[\frac{hp'}{2\mu} - \frac{D_1}{2(1 - N^2)}(Coshmh - 1)\right] - \frac{zp'}{2\mu} \quad \text{(x)}$$

Where

$$m = \left\{\frac{4\mu\chi}{\gamma(2\mu + \chi)}\right\}^{1/2},\ N = \left(\frac{\chi}{2\mu + \chi}\right)^{1/2},\ D_1 = \frac{-(1 - N^2)}{2}\left(\frac{hp'}{\mu}\right),\ l = \left(\frac{\gamma}{4\mu}\right)^{1/2}$$

Integrating equation (6) after substituting the expression of *u* the result provides

$$\frac{1}{r}\frac{\partial}{\partial r}\left[\left(r\frac{\partial p}{\partial r}\right) f(N,l,h)\right] = 12\mu\frac{dh_m}{dt} \quad \text{(xi)}$$

Where $f(N,l,h) = h^3 + 12l^2 h - 6Nlh^2 Coth\left(\frac{Nh}{2l}\right)$

The mathematical expression used to describe film thickness that represents rough surfaces is referred to as

$$H = h + h_s(r,\theta,\xi) \quad \text{(xii)}$$

By taking a stochastic average in equation (11), we can get

$$\frac{1}{r}\frac{\partial}{\partial r}\left[\left(r\frac{\partial E(p)}{\partial r}\right) E\left[f(N,l,H)\right]\right] = 12\mu\frac{dh_m}{dt} \quad \text{(xiii)}$$

Where $E(\circ) = \int_{-\infty}^{\infty} (\circ)\, f(h_s)\, dh_s$ (xiv)

The probability distribution function $f\left(h_s\right)$ is provided as

$$f\left(h_s\right)=\begin{cases}\dfrac{35}{32c^7}\left(c^2-h_s^2\right)^3 & -c<h_s<c\\ 0 & otherwise\end{cases} \quad \text{(xv)}$$

Where $\overline{\sigma}$ is standard deviation, h_s signifies the thickness of the stochastic film, and $c=3\overline{\sigma}$.

Roughness structures are divided into two categories which are analyzed within Christensen's stochastic model.

Radial Roughness

To determine radial roughness in one dimension the construction of the surface includes ridges that are long but narrow as well as valleys that run in the path of radial. Therefore, the film has a thickness determined by

$$H=h+h_s\left(\theta,\xi\right) \quad \text{(xvi)}$$

Thus, stochastic Reynolds's equation (13) is obtained as

$$\frac{1}{r}\frac{\partial}{\partial r}\left\{\left(r\frac{\partial E\left(p\right)}{\partial r}\right)E\left[f\left(N,l,H\right)\right]\right\}=12\mu\frac{dh_m}{dt} \quad \text{(xvii)}$$

Azimuthal Roughness

When it refers to azimuthal roughness in one dimension, the surface structure is composed of ridges that are long but narrow as well as valleys **that run in an azimuthal path. Therefore,** the film has a thickness **determined by**

$$H=h+h_s\left(r,\xi\right) \quad \text{(xviii)}$$

Therefore, the equation of stochastic Reynolds (13) is written in the following form

$$\frac{1}{r}\frac{\partial}{\partial r}\left\{\frac{1}{E\left[\dfrac{1}{f\left(H,N,l\right)}\right]}r\frac{\partial E\left(p\right)}{\partial r}\right\}=12\mu\frac{dh_m}{dt} \quad \text{(xix)}$$

The combination of the equations (17) as well as (19) results in

$$\frac{1}{r}\frac{\partial}{\partial r}\left\{G\left(N,l,H,c\right)r\frac{\partial E\left(p\right)}{\partial r}\right\}=12\mu\frac{dh_m}{dt} \quad \text{(xx)}$$

Where

$$G\left(H,N,l,c\right)=\begin{cases}E\left[f\left(H,N,l\right)\right] & for\ radial\ roughness\\ \left\{E\left[\dfrac{1}{f\left(H,N,l\right)}\right]\right\}^{-1} & for\ azimuthal\ roughness\end{cases}$$

$$E\left[f\left(H,N,l\right)\right]=\frac{35}{32c^7}\int_{-c}^{c}f\left(H,N,l\right)\left(c^2-h_s^2\right)^3dh_s \quad E\left[\frac{1}{f\left(H,N,l\right)}\right]=\frac{35}{32c^7}\int_{-c}^{c}\frac{\left(c^2-h_s^2\right)^3}{f\left(H,N,l\right)}dh_s$$

Presenting the following dimensionless variables

$$H^* = h^* + h_s^*, h_s^* = \frac{h_s}{h_0} r^* = \frac{r}{a}, h^* = \frac{h}{h_0}, h_m^* = \frac{h_m}{h_0}, l^* = \frac{l}{h_0}, K = \beta a^2, Q = \alpha a^2,$$

$$P^* = \frac{E(p) h_0^{\ 3}}{\mu a^2 \left(-dh_m / dt \right)}, C = \frac{c}{h_0} \ \& \ h^* = h_m^* \left\{ \sec(Kr^{*2}) - \sec(Qr^{*2}) + 1 \right\}$$

Equation (20) transforms into

$$\frac{\partial}{\partial r^*} \left[G\left(N, l^*, H^*, C\right) r^* \frac{\partial P^*}{\partial r^*} \right] = -12 r^* \qquad \text{(xxi)}$$

Where,

$$G\left(H^*, N, l^*, C\right) = \begin{cases} E\left[f\left(H^*, N, l^*\right) \right] & \textit{for radial roughness} \\ \left\{ E\left[\dfrac{1}{f\left(H^*, N, l^*\right)} \right] \right\}^{-1} & \textit{for azimuthal roughness} \end{cases}$$

$$E\left[f\left(H^*, N, l^*\right) \right] = \frac{35}{32C^7} \int_{-C}^{C} f\left(H^*, N, l^*\right) \left(C^2 - h_s^2\right)^3 dh_s$$

$$E\left[\frac{1}{f\left(H^*, N, l^*\right)} \right] = \frac{35}{32C^7} \int_{-C}^{C} \frac{\left(C^2 - h_s^2\right)^3}{f\left(H^*, N, l^*\right)} dh_s$$

and $f^*(H^*, N, l^*) = H^{*3} + 12 l^{*2} H^* - 6 N l^* H^{*2} \coth\left(\dfrac{NH^*}{2l^*} \right)$

In the case of the present squeezing problem the boundary conditions include:

$$\text{At } r^* = 0, \ \frac{dP^*}{dr^*} = 0 \qquad \text{(xxii)}$$

$$\text{At } r^* = 1, \ P^* = 0 \qquad \text{(xxiii)}$$

Integrating equation (21) with the above boundary conditions (22) and (23) yields the pressure in the non-dimensional form of squeeze film

$$P^* = -6 \int_1^{r^*} \frac{r^*}{G\left(N, l^*, H^*, C\right)} dr^* \qquad \text{(xxiv)}$$

The capacity to carry loads is determined by integrating pressure on the film across the film's region

$$E(W) = \int_{r=0}^{a} 2\pi r E(p) dr \qquad \text{(xxv)}$$

The capacity of load-supporting in a dimensionless manner is defined by

$$W^* = \frac{E(W) h_0^3}{2\pi\mu a^4 \left(-dh_m / dt \right)}$$

$$= -6\int_0^1 \left\{ \int_1^{r^*} \frac{r^*}{G\left(H^*, N, l^*, C\right)} dr^* \right\} r^* dr^* \qquad \text{(xxvi)}$$

The response time **in a dimensionless manner is determined by**

$$T^* = \frac{E(W) h_0^2}{2\pi\mu a^4} t$$

$$= -6\int_{h_m^*}^1 \left[\int_0^1 \left\{ \int_1^{r^*} \frac{r^*}{G\left(N, l^*, H^*, C\right)} dr^* \right\} r^* dr^* \right] dh_m^* \qquad \text{(xxvii)}$$

RESULTS AND DISCUSSION

The impacts of surface roughness and micro polar fluids on the dynamic characteristics are clearly shown in the preceding analysis of secant curved circular plates are affected by three non-dimensional parameters as the roughness parameter $C = c/h_0$ as well as the coupling parameter $N = (\chi/\chi + 2\mu)^{1/2}$ and an interconnected parameter $l^* = l/h_0 = (\gamma/4\mu)^{1/2}(1/h_0)$. Additionally, the non-dimensional curvature parameters, $K = \beta a^2$ and $Q = \alpha a^2$ are the dominant geometric effects on secant curved circular plates. This research focuses on the combined influence of micro polarity and roughness on the surface on dynamics of circular plates that are secantly rough for $C \neq 0, N \neq 0 \, and \, l^* \neq 0.$

Pressure of Squeeze Film

Figure 2 demonstrates, deviance of distribution of pressure P^*, which is dimensionless to its non-dimensional parameter radial, r^* for various C values under $l^* = 0.02, Q = 0.6, K = 0.6, N = 0.3$ & $h_m^* = 0.6$. The pressure values are seen to diminish as the radius parameter is increased. Consequences of radial roughness are seen to cause a reduction in the estimation of pressure compared with the smooth plate. However, the impact of the azimuthal roughness has been predicted to enhance the pressure. Also, the impacts of surface roughness have been examined on the pressure attributes of circular plates that are non-Newtonian-lubricated are even more evident for the higher value of roughness and low radius parameters' values. The graph of P^* versus the value of r^* for various of N, l^* and Q values is illustrated in Figures 3, 4, and 6, correspondingly. It can be detected that P^* increases significantly when the values are higher for N, l^* and Q in both roughness patterns. However, in Figure 5, the variations of pressure P^* in relation to r^* for various K values with set values for $l = 0.3, C = 0.2, Q = 0.2, h_m^* = 0.6$ & $N = 0.2$ is illustrated. It is apparent how the pressure decreases with the higher K values for both roughness patterns.

Load Supporting Capacity

Figure 7 illustrates the load capacity W^* versus curve parameter K for the different roughness parameters C, with $h_m^* = 0.6$. Results of $C = 0.1$ and 0.2 provide the capacity to carry the load for circular plates using micro polar liquid $\left(N = 0.3, l^* = 0.3\right)$, anticipating the influence of roughness on the surface. The load's ability for circular plates increases with the curvature parameter until an absolute maximum is achieved and, after that, drops when the value of K prevails to grow. Also, it is noticed that the roughness effects in the radial direction decrease in W^*

associated to plates with surfaces which is smooth. However, the results of azimuthal roughness led to an improvement in the magnitude of the capacity to carry the load. The graph of W^* versus K for distinct N and l^* values is illustrated in Figures 8 and 9, correspondingly. It can be detected that W^* increases significantly when the values are higher for N and l^* in both types of roughness. Figure 10 illustrates the capacity of load bearing W^* upon curve parameter Q for the various roughness parameters C, and $h_m^* = 0.6$. Results of $C = 0.1$ and 0.2 provide the load capacity for circular plates using micro polar fluid $\left(N = 0.3, l^* = 0.3\right)$, in view of the roughness effect on the surface. The load's ability for circular plates decreases with the curvature parameter until an absolute minimum is achieved and, after that, rises when the Q value prevails to grow. Also, it has been determined that the effects of roughness in the radial direction reduced in W^* contrasted to plates with surfaces that are smooth. However, azimuthal roughness's outcomes led to an improvement in the magnitude of the load capability. A graph of the W^* and the curvature parameter Q in distinct N and l^* values is revealed in figures 11 and 12, respectively. W^* rises significantly when the values are higher for both N and l^* in both roughness patterns.

Squeeze Film Time of Response

Figure 13 illustrates the deviation in the time response T^* which is dimensionless to its film thickness h_m^*, a non-dimensional parameter, for different C values under $l^* = 0.3, Q = 0.3, N = 0.3$ & $K = 0.3$. The values of time are witnessed to decline with a rise in the film thickness parameter. Effects of roughness in the radial direction appear as causing a decrease in the amount of time compared to a smooth plate. But, the impact of the roughness in the azimuthal direction is expected to prolong the time. Additionally, it is noted that the roughness effect on the time features on circular plates that aren't Newtonian-lubricated are evident with higher roughness values as well as the low value of the thickness parameter. A graph of the T^* against the h_m^* value for various values of N and Q can be seen in Figures 14 and 16 respectively. T^* rises significantly when the values are greater for N and Q in both patterns of roughness. In Figure 15, the variations in time T^* and h_m^* for discrete K values, together with fixed parameters of $l^* = 0.3, Q = 0.3, C = 0.2$ & $N = 0.3$, is depicted. The duration decreases with higher K values for both roughness patterns. Thus, the roughness pattern of the azimuthal structure is characterized by valleys and ridges which run in the trend of circumferential flow. It can limit the flow available and consequently reduce the flow of fluid. This increases the pressure of the film besides capacity of the load, and the time to squeeze are anticipated. For radial roughness patterns, the shape of valleys and ridges that run across the entire radial channel is likely to increase the flow of lubricant; the effect of radial roughness on secant curved circular plates pressure, load capacity, as well as the time to squeeze, are then reversed.

CONCLUSION

The current paper has examined the effects of the roughness of the surface then on the dynamic performance of curved circular secant rough plates with non-Newtonian lubricants. Conclusions should be formed in the following manner based on the findings and discussions. Under the micro-continuum concept of micro polar fluids from Eringen [2] and including the model of surface roughness developed by Christensen [5], the non-Newtonian stochastic dynamic the Reynolds equation was devised for circular plates with secant roughness. It is found that the roughness pattern of azimuthal patterns increases constant pressure, capacity for load and response time contrasted to the smooth plate that is lubricated by micro polar fluids. The radial roughness structure reduces the capacity to carry the load, pressure and time of response. In general, the effects of coupling of roughness on the surface and the

micro polar fluids on performance properties are particularly noticeable for circular plates with higher non-Newtonian coupled parameter, interface parameter, and surface roughness parameter values.

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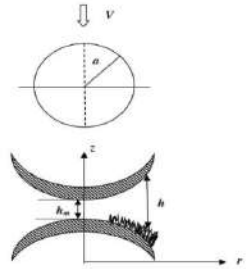


Figure 1 Squeeze film action between the secant rough curved circular plates

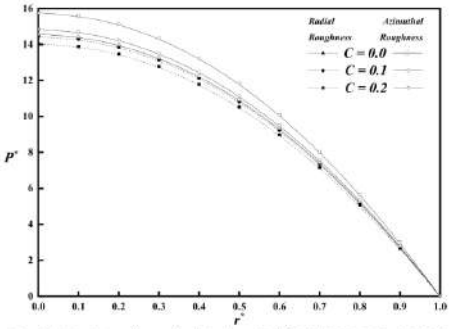


Figure 2 Variation of Pressure P^* versus r^* for distinct values of C with $l^*=0.02$, $K=0.6$, $Q=0.6$, $h_m^*=0.6$, & $N=0.3$

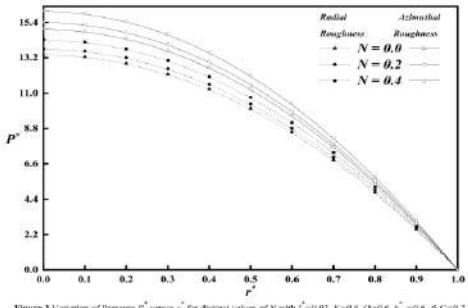


Figure 3 Variation of Pressure P^* versus r^* for distinct values of N with $l^*=0.02$, $K=0.6$, $Q=0.6$, $h_m^*=0.6$, & $C=0.2$

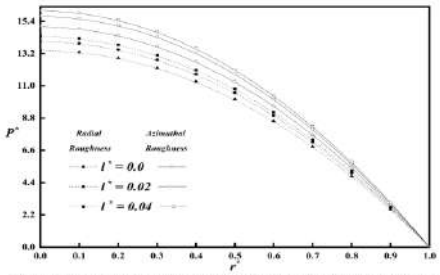


Figure 4 Variation of Pressure P^* versus r^* for distinct values of l^* with $C=0.2$, $K=0.6$, $Q=0.6$, $h_m^*=0.6$, & $N=0.3$

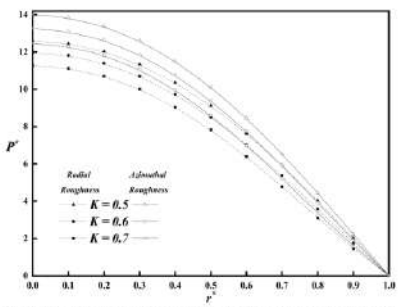


Figure 5 Variation of Pressure P^* versus r^* for distinct values of K with $l^*=0.3$, $C=0.2$, $Q=0.2$, $h_m^*=0.6$, & $N=0.2$

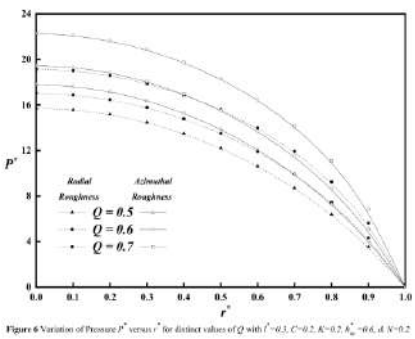


Figure 6 Variation of Pressure P^* versus r^* for distinct values of Q with $l^*=0.3$, $C=0.2$, $K=0.2$, $h_m^*=0.6$, & $N=0.2$

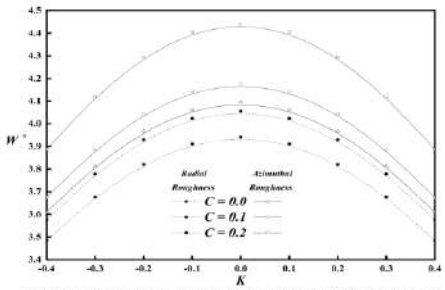


Figure 7 Load carrying capacity W^* versus K for distinct values of C with $\bar{l}^*=0.3$, $Q=0.2$, $h_m^*=0.6$, & $N=0.3$

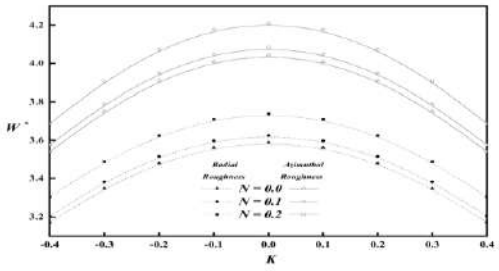


Figure 8 Load carrying capacity W^* versus K for distinct values of N with $\bar{l}^*=0.3$, $Q=0.3$, $h_m^*=0.6$, & $C=0.2$

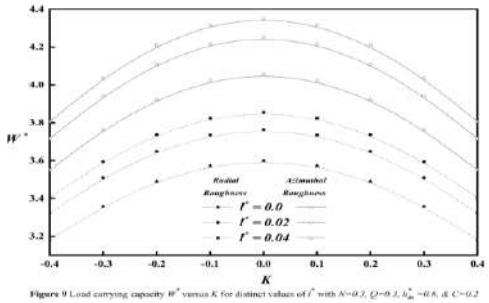


Figure 9 Load carrying capacity W^* versus K for distinct values of $\bar{l}^*$ with $N=0.3$, $Q=0.3$, $h_m^*=0.6$, & $C=0.2$

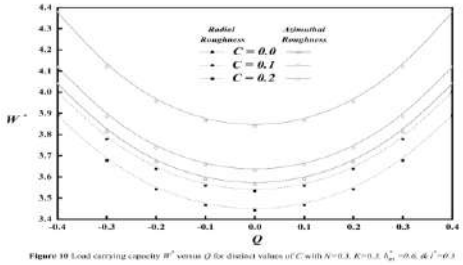


Figure 10 Load carrying capacity W^* versus Q for distinct values of C with $N=0.3$, $K=0.3$, $h_m^*=0.6$, & $\bar{l}^*=0.3$

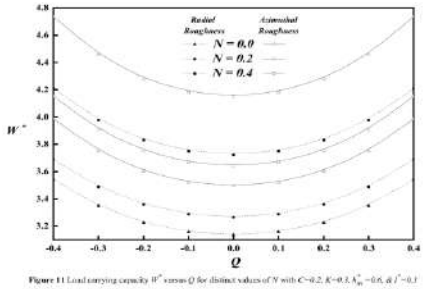


Figure 11 Load carrying capacity W^* versus Q for distinct values of N with $C=0.2$, $K=0.3$, $h_m^*=0.6$, & $\bar{l}^*=0.3$

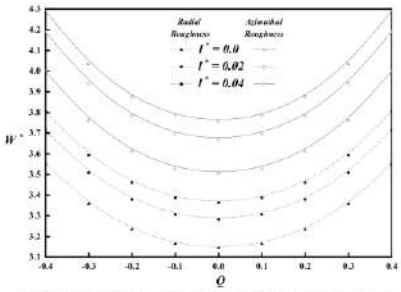


Figure 12 Load carrying capacity W^* versus Q for distinct values of $\bar{l}^*$ with $C=0.2$, $K=0.3$, $h_m^*=0.6$, & $N=0.3$

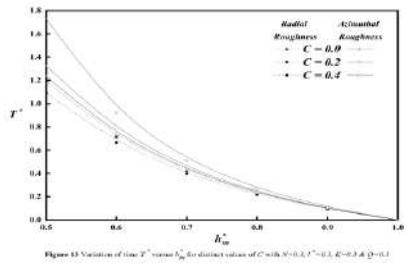


Figure 13 Variation of time T^* versus h_m^* for distinct values of C with $N=0.3$, $\bar{l}^*=0.3$, $K=0.3$ & $Q=0.1$

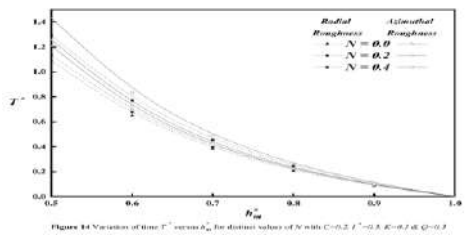
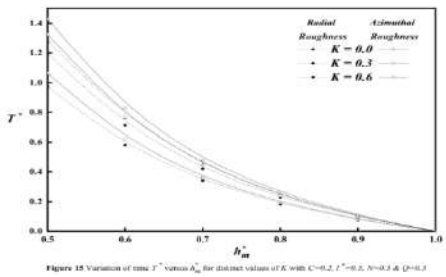
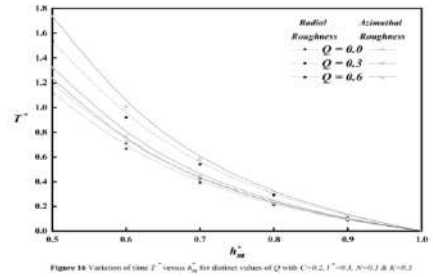


Figure 14 Variation of time T^* versus h_m^* for distinct values of N with $C=0.2$, $\bar{l}^*=0.3$, $K=0.3$ & $Q=0.3$





Nomenclature

a The plate's radius;

h Thickness of the film;

h^* Film thickness, non-dimensional;

h_m Minimum thickness of the film;

h^*_m Minimum non-dimensional film thickness;

H Film thickness, $h_s + h$;

h_s A portion of the film's thickness due to surface asperity;

l Interacting parameter, $\left(\gamma/4\mu\right)^{1/2}$;

l^* Interacting parameter, non-dimensional, $\left(l/h_0\right)$;

N Number of couplings, $\left\{\chi/\left(2\mu+\chi\right)\right\}^{1/2}$;

p Pressure in the film sector;

P^* Dimensionless fluid pressure on the film;

r, z Coordinates in radial and axial directions;

r^* Radial coordinate with non-dimensional;

t Time of approach;

T^* Dimensionless squeeze film time;

u, w In the r and z directions, velocity components;

W Capacity to bear loads;

W^* Capacity to bear a load with non-dimensional;

c Parameter for roughness;

C Roughness parameter in non-dimensional, $\left(c/h_0\right)$;

w_1 Component of micro rotational velocity;

χ The viscosity of spin;

γ The material coefficient or viscosity coefficient;

μ Classical viscosity coefficient;

β, α Curved shape parameters, and

K, Q Non-dimensional curved shape parameters.

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RESEARCH ARTICLE

Bioremediation and Biomass Production from *Tetradesmus deserticola* Isolated from the Lakes of Davangere, Karnataka, India

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ABSTRACT

The present investigation has been carried out to study the diversity of microalgae governed by their physicochemical parameters in the lakes of Davangere district, India. Overall, 128 microalgal genera were documented including 41 genera (34%) of Chlorophyceae members. Among these, the microalgae genus *Scenedesmus* were frequently encountered with a total of 21 species from the seven study sites of which site 3 was documented with high diversity. Statistical analysis indicated that nutrients such as PO_4^{-}, NO_3^{-}, Cl^{-}, Mg^{++}, SO_4^{--},DO, pH, Temperature, and turbidity were the most important factors regulating the variation in the structure of the microalgal community. Based on the high relative abundance and species number, three taxa of *Scenedesmus* viz., *Scenedesmus dimorphus* (8.4), *Scenedesmus quadricauda* (7.1), and *Scenedesmus deserticola* (5.5), were found to be predominant. The isolate GMAJ0519 was identified as *Tetradesmus deserticola* (also known as *Scenedesmus deserticola*). The identified *Scenedesmus* sp., were cultivated using Food Waste Hydrolyzed Broth (FWHB), Corn Steep waste (CSLW) and Dairy Wastewater (DWW) maximum biomass was produced 1.45 gm/L, 1.13 gm/L and 0.74 gm/L with the specific growth rate of 0.362, 0.379 and 0.46 μd^{-1} respectively and overall lipid production was 40%. The mean nutrient uptake was observed of *Scenedesmus* sp. was of Nitrate (58%), Phosphate (65%) and COD (44%). Our study suggests *Scenedesmus* sp. plays a significant role as an ecological indicator of the aquatic ecosystem and its biomass could serve as feedstock for biofuel production.

Keywords: *Tetradesmus deserticola*, Phylogenetic analysis, Davangere District, Agro-industrial waste, Bioremediation, Food Waste Hydrolyzed Broth.

INTRODUCTION

Algae are the dominant primary producers in lakes and ponds and are found in virtually every water body where there is sufficient light for photosynthesis. Knowledge of freshwater algae that respond rapidly and predictably to environmental change has been particularly useful, with the identification of particular indicator species or combinations of species being widely used in assessing water quality [1]. The green microalgae and cyanobacteria typically found in freshwater and marine systems are an important group of unicellular (3–10 μm) photosynthetic microorganisms with great economic and ecologic impact. Documentation of the patterns in the biodiversity of primary producers might be important due to its innate relationship with ecosystem function [2]. Freshwater microalgae are widely distributed in rivers, lakes and polar waters and they exhibit a diverse range of cellular, morphological, structural and biochemical compositions [3]. Due to their tendency to grow quickly, their capacity to adapt to harsh environmental conditions, and their ease of cultivation, several species of this genus are utilized for various applications throughout the world [4]. Certain strains require different types of nutrient supply and intake, as well as specific environmental and cultivation conditions [5]. Isolation of new species is often accompanied by several challenges including lack of knowledge regarding metabolic requirements of the species for growth, nutritional requirements as well as pH and other growth parameters such as temperature and culture density.

Microalgae have drawn great attention as a promising source for the sustainable production of various bioactive compounds. These include fatty acids, phycobiliproteins, chlorophylls, carotenoids, and vitamins, all of which are widely utilized as ingredients and additives in medications, cosmetics, and food products [6]. Microalgae have a longer evolutionary history than terrestrial plants; show a rich diversity among more than 200,000 species [7]. However, 30,000 species have been studied, but they were not been fully exploited [8]. Among these, *Scenedesmus*, which belongs to the order Sphaeropleales of the family Scenedesmaceae is a dominant microalgae in fresh water lakes and rivers [9]. The genus *Scenedesmus* was described as a diverse group of species with different morphological characters. *Scenedesmus* Meyen is the most abundant and diversified genus of chlorococcalean found in freshwater; with 2, 4, 8 or 16 cells arranged in a row [10]. *Scenedesmus* sp. has been used in bioremediation and numerous biotechnological applications due to its high nutritional content and bioactivities [11]. Davangere district is the sixth-largest city which is situated at the heart of the state of Karnataka, and due to rapid urbanization and migration have led to high densities, infrastructure, and extreme congestion that have impacted environmental conditions and aquatic biodiversity. There is little documentation about the exploration of microalgae in the lakes from this locality. Therefore, the main objectives of the present work were to study the correlation of green microalgal distribution and isolation of genera *Scenedesmus* from the lakes of the Davangere district and to evaluate their ability to grow in agro-industrial wastewater.

MATERIALS AND METHODS

Sampling sites and water quality

Davanagere district is located in the mid-eastern region of the Karnataka state, between the 13° 45' 00" N to 14° 50' 00" N latitude and75° 30' 00" E to 76° 30' 00" E longitude and its elevation is about 602.5 m above the mean sea level. The district has six taluks such as Harihar, Davangere, Honnali, Channagiri, Jagalur and Harpanahalli (Now considered under Vijaynagara District judiciary)**.** The lakes **(Figure- 1)** selected for the study include Anaji (**S1**), Ayyankere (S2), Bathi (S3), Kondaji (S4), Kundwada (S5), Devarabelakere (S6) and Shanthisagar (S7). The water samples were collected monthly from September 2018 to August 2019 from the sampling sites. The temperature, color, pH, conductivity, TDS and DO parameters in these water samples were analyzed. Further, the water samples were

collected in a sterile screw-caped container and carried to the laboratory for determining nutrient and organic constituents by following standard methods of APHA [12].

Isolation of microalgae

The microalgal study was conducted monthly from the selected sampling sites by using the modified Lackey's drop method. Here, the total number of microalgae present was calculated (cells/L) using a stereo binocular microscope (Lawrence and Mayo, India) with 40X magnification. Chlorophyceae members were identified using standard keys as provided by Fritsch and Desikachary [13], Prescott [14] and Algae Base [15]. The pure cultures were obtained by centrifugation, washing and streak plating technique [16]. The water samples were collected aseptically from the sampling sites and 10 mL of it were transferred to a 500 mL conical flask containing 200 mL of sterilized Bristol, BG11, CHU and BBM media separately and incubated on a rotary shaker at 150 rpm in room temperature (27°C) and continuously illuminated using white fluorescent light at an intensity of 20 mol/m/s for four weeks under 16:8 h light/dark cycle [17]. Further, subcultures were obtained by progressive dilutions of the original sample. A volume of 10 mL microalgal sample was taken aseptically from enrichment culture and centrifuged at 3000 rpm for 15 min. The supernatant was removed and the cells were washed in sterile distilled water. The cells were streaked onto BG11 agar medium upon centrifugation to obtain the pure culture. Isolated cells were observed for purity and their morphological characteristics were carried out using a digital light microscope (Lawrence and Mayo, India).

Cultivation of microalgae in optimized wastewater

The wastewater used as a culture medium was food wastewater collected from Sahyadri Science College Cafeteria, Shimoga, Dairy wastewater was collected from SHIMUL Dairy, Shimoga, and the Corn Steep Liquor from Cargill Pvt. India Ltd., Harihar, Davangere. Samples were subjected to sedimentation and filtration and diluted with water. A 3% Sulphuric acid was added to the mixture to hydrolyze the polysaccharides, and proteins in the medium and autoclaved for 15 min at 121°C and the autoclaved mixture was optimized with NaoH following the methods of Badar *et al.,* (2017) [18] and filtrate obtained is Food Waste Hydrolyzed water (FWHB), Dairy Wastewater (DWW), Corn steep Liquor wastewater (CSLW). The concentration of this culture medium before cultivation and after cultivation were analyzed as mentioned above following the standard methods of APHA and data were tabulated in **(Table-5).** Cultivation was performed using a Plastic containers with the following dimensions 25cm x 50cm respectively, with a working volume of 20L and cultivation was supplemented with an optimized culture medium with pH 7.2±3, and it was inoculated with 5 % (v/v) seed culture of *Tetradesmus* sp. (MZ325423), under 16:8 hrs Light: Dark, continuous illumination of 3000 lm (36W) by using white LED lamps for 25 days at 25 °C and the aeration was carried out by sparging filtered air (using 0.2 ml syringe filter) from the top, followed by the methods of de Melo *et al*., (2018), Mujeeb *et al.,*(2020)[19,20]. Quantification of wastewater after cultivation for the Removal efficiency (RE, %) of the strains used was calculated by the equation:

$$\mathbf{R.E\%} = \frac{S1-S2}{S1} \times \mathbf{100} \qquad \mathbf{(1)}$$

Where, S1- Initial and S2-Final are the nutrient concentrations of the wastewater in cultivation of microalgae respectively.

Determination of Growth studies and biomass, lipid content

The growth of microalgal species in the broth and wastewater was studied every five days by measuring its optical density at 680 nm using a spectrophotometer and cell count was made using a hemocytometer with a suitable dilution. Further, cell biomass was harvested by centrifugation and dried at 40°C and the weights of the wet and dry samples were measured. The total lipid fraction in the algal biomass was extracted according to Bligh and Dyer's method [21], where methanol–chloroform solvent system (2:1 v/v) were used and analyzed using gravimetric quantification methods according to the procedure of Han *et al*. (2011) [22]. Specific growth (μ), Biomass productivity (B) and Lipid content % were calculated using the formula described in equations 2, 3 and 4:

$$\textbf{Specific Growth } (\boldsymbol{\mu}) = \frac{\ln(N1-N2)}{t2-t1} \qquad \mathbf{(2)}$$

Where N1 and N2 are initial and final biomass produced at time (t1) and time (t2).

Biomass productivity $(\boldsymbol{B}) = \frac{(\boldsymbol{B_1}-\boldsymbol{B_0})}{(\boldsymbol{T_1}-\boldsymbol{T_0})}$ **(3)**

Where B0 and B1 is the mean Dry biomass and Lipid productivity at the times T0 and T1, respectively.

Total lipid (%)$= \frac{\mathbf{W_2}-\mathbf{W_0}}{\mathbf{W_1}} \times \mathbf{100}$ **(4)**

Where W_1 is the weight of the dried algal cells, W_0 is the weight of the empty new screw cap tube and W_2 is the weight of the new screw cap tube with the dried lipids.

Statistical analysis

The data were statistically analyzed using MS Excel, 2010; One-way ANOVA multivariaent analyses were performed using Graphpad prism software. The Pearson correlation (P<0.05) was applied to study the correlation between specific growth rate and biomass productivity. The Canonical Correspondence Analysis (CCA) was applied to establish the link between physicochemical factors and Chlorophyceae distribution in different stations using the PAST v 4.03. [23].

RESULTS AND DISCUSSION

The present study signifies the distribution of Chlorophyceae members with the water quality based on its environmental parameters in the lakes of the Davangere district, fluctuation in the physiochemical properties was noted in the seven sampling sites tabulated in **(Table-1)** Physical parameters like temperature, pH and nutrients such as nitrate, phosphate, sulphate and carbonates played a vital role in *Scenedesmus* sp. distribution, slight variation in the temperature was observed among the study sites with respect to seasons, the mean ambient temperature was 27.5 ^{o}C and pH was 7.3 ±0.6, which is optimum for the growth of microalgae. Nutrients like nitrate and phosphate are directly proportional to human activity and influence green algal growth. The S2- Ayiankere was highly concentrated with nitrate (2.9 mg/L) phosphates (2.3 mg/L), chloride (121 mg/L) and sulphates (75 mg/L), followed by S3-Bathi lake nitrate (1.4 mg/L), phosphates (1.1 mg/L), chloride (98 mg/L) and sulphates (45 mg/L), S4-Devarabelakere lake (1 mg/L), (0.8 mg/L), (55 mg/L) and (31 mg/L). S7- Shanthishagara Lake showed low nitrate (0.42 mg/L), phosphates (0.1 mg/L), chloride (18 mg/L) and sulphate (16 mg/L) concentration. The Dissolved oxygen concentration varied from 3-7 mg/L where S7-Shanthisagar (7), S4-Kondajji (6.5) and S1-Anaji (6) were less polluted and with high dissolved oxygen (>6) throughout the year. The S2- Lake was noted with 3 mg/L in the summer season.

In the present study, over 130 microalgal genera belonging to five different classes' viz., Chlorophyceae, Bacillariophyceae, Euglenophyceae, Cyanophyceae, and Dinophyceae were reported from the study area. Among them, Chlorophyceae members contributed 34% which includes 41 genera and 166 species were documented in the seven study area. The site S3 was highly diversified with 21% of green algae followed by S4 (16%), S1 (15%) and least was S7 (8%) **(Table-2)**. The species dynamics of microalgae have changed with the alteration of physicochemical factors and each species responds differently to the environmental factors. To find out this relationship, a canonical correspondence analysis (CCA) was done. Results from a CCA analysis based on normalized environmental variables in 7 sampling sites, the eigenvalues and the percentages of variance on axis 1 are found to be higher than on axis 2. Between physicochemical factors and Chlorophyceae species, the eigenvalue for axis-1 (0.18013) explains 55.5% correlation, while axis-2 (0.12301) explicates 37.20% correlation. In 41 Chlorophyceae species documented, 8 predominant species were highlighted as a bio-indicator in data analysis using CCA **(Figure-2).** *Chlorella* sp. *Chlorococcum* sp. *Coelastrum* sp. *Pandonrina* sp. *Pediastrum* sp. and *Staurastrum* sp. indicate that they are positively correlated with the higher value of PO_4^-, NO_3^-, Cl^- in sites of S2, S3 and S4 respectively. Simultaneously D.O, pH and water temperature were correlated with few species where, the lakes were less contaminated and were found to be

least affected by the variation of physicochemical factors and our observations were in concern with the earlier studies of Arsad *et al.,* (2022) [24] and Halder *et al.,* (2019) [25].

Based on their diversity and high relative abundance, these species mainly *Scenedesmus* sp. served as a pollution indicator as they are the predominant species in all the study sites and these species have proved to be pollutant tolerant, our study confirms the earlier studies [26]. The Pearson correlation studies between *Scenedesmus* sp. and the water constituents showed statistically significant differences ($P< 0.05$) and had a positive correlation with turbidity, phosphate and nitrate, BOD, Negative correlation with DO and temperature, pH, conductivity, alkalinity and Mg^{++}, Ca^{++} **(Table-3).** Azim *et al.,* (2002) reported that *Scenedesmus* sp. is a common microalga that may be found in all sorts of freshwater bodies and serve as a significant primary producer and aids restoration of eutrophic waters [27]. Totally 21 species of *Scenedesmus* sp. were documented during the isolation process, Among which one strain (GMAJ0519) was isolated from the S1 site and tested for its growth efficiency on synthetic and culture media and later assays were performed. Morphological appearances of the isolate revealed their colonial existence as the cells were forming distinct colonies on growth media and microscopic observation showed cells characteristics of crescent-shaped single uninucleate chloroplast, single elongated cells were also clearly visible measuring cells 3-8 microns width, 3 times long as wide and oval cells 7-21 microns wide by 8-24 microns long **(Figure-3).** The isolated strain *Scenedesmus deserticola* was originally described by Smith [28] and this name is currently regarded as a synonym of *Tetradesmus deserticola* [29]. Based on the BLAST analysis 'nr' database revealed that microalgal isolate was closely related to microalgae belonging to the genus *Scenedesmus* sp. with 99.9 % identity. Therefore, the microalgal isolate was confirmed as a member of the genus *Scenedesmus* and species *Tetradesmus deserticola* (NCBI Accession Number - MZ325423), our results have correlates with earlier reports of Lewis and Flechtner (2019) [29].

Further isolated strain (MZ325423) was cultured and cultivated on a laboratory scale using agro-industrial wastewater for biomass generation. Based on the above diversity studies, the occurrence and adaptation of microalgae with the water constituent significantly helped in the formulation of low-cost media. The cultivation of microalgae was carried out accordingly using optimized wastewater with an incubation period of 25 days. The results indicated that *T. deserticola* has shown similar trends and adhered to the standard growth curve in nutrient media and wastewater, algal growth was studied at OD 680 nm and its specific growth rate and biomass productivity were summarized accordingly (**Table-4).** The cultivated microalgae underwent lag, exponential, and stationary phases, when growing in both synthetic and culture mediums, which supported microalgal growth positively as also shown by Moussa *et al.,* (2021) [30]. Based on the growth curve represented in **(Figure-4),** the lag phase ($\mu \approx 0$) of all the species was consistent from day 1 to day 5($\mu < \mu$ max), followed by ($\mu \approx \mu$max) exponential phase (day 6 to day 12), and stationary phase ($\mu < \mu$ max) (day 13 to day 18) and decline (death) ($\mu=0$) phase was achieved after 21 days and the results were correlated with the cell number and biomass, to determine specific growth rate (μ, d^{-1}) and biomass productivity (B). The rate of cell division has varied according to the nutrient concentration and their living conditions. The genus *T. deserticola* significantly showed exponential growth in Modified BG11 broth with the highest O.D of 1.973 and dry weight 1.673 g/L, similarly in CHU and Bolds broth 1.22, 1.10 O.D, and dry weight 1.152, 1.104 g/L. The least growth and productivity were observed in Bristol broth with O.D 1.017 and dry weight of 0.89 g/L. Comparatively in wastewater, FWHB and DWW proved to be a good source for cultivation with O.D 1.24, 1.04. and its dry weight g/L 1.29, 0.87 and in CSLW, growth was found to be average of all the three culture media with 0.750 O.D, dry weight 0.612 g/L**,** which is due to low pH and high concentration sugar whereas, FWH and DWW supported the growth of microalga.

Similarly, Thanh (2019) and Brar *et al.,* (2019) [31, 32] have produced the highest specific growth rate of 1.92 μ d^{-1} biomass productivity and lipid in fruit waste hydrolysates and food waste hydrolysate and Dairy waste using *Chlorella vulgaris* and *Scenedesmus* sp. Lipids are among the major constituents of microalgae biomass apart from protein and carbohydrate, having high market value and also raw materials for biofuel. The organisms used in our study *Tetradesmus deserticola* yielded high lipid 31.1% to 40.8% of its dry weight and growth yield is determined by its specific growth rate and biomass productivity **(Table-4, Figure-5).** The most common microalgal biofuel products are biomethane and lipid, but productivity or yields may vary with genera and the utilization of wastewater as low-cost

substrate for generating biofuel and value-added compounds, could enhance productivity and simultaneously it reduce costs [35]. The total lipid content of the screened algae is similar to the earlier report of Pham *et al.,* (2020) [36], where Pb metal ion had a great influence on algal growth and lipid production of *Scenedesmus* sp. The selection of appropriate microalgal strain is an important factor for the overall success of the by-product resulting from the microalgae [37].The wastewater contains high amounts of nitrogen and phosphorous that poses a serious concern to the environment in the form of eutrophication and the research has been focused on the utilization of nutrients from the wastewater before its discharge into the natural water bodies [33]. Cultivation coupling with nutrients absorption is added sustainable process; the reduction in biomass growth could be attributed to the deficiency of nutrients in the growth media (**Table-5),** which signifies the nutrient removal before and after cultivation. *Scenedesmus* sp. found to be efficient as utilization of nutrients nitrate, phosphate and carbon source in all the wastewater rate is high in FWHB with COD 50 %, sugars 76.6 %, NO_3^- 66 %, PO_4^- 75%, which is followed by DWW 37.5 %, 75.5 %, 58.9 %, 72.2 % and CSLW 45%, 33.3 %, 43.3%, 50% described in **(Figure-6).** Mercado *et al.*(2020) [34] recently worked on *Scenedesmus* sp. which has achieved high percentages of biomass utilizing nutrients in dairy wastewater 88.41% and 97.07% for nitrogen and phosphorus, respectively. Our result correlates similarly in the biomass production using FWHB, DWW and CSLW. Our results are very promising for a potential application of this microalga as an efficient and economic biomaterial for wastewater treatment and biofuel production. The knowledge obtained from this research can be used to create a database that can be employed to evaluate the impact of anthropogenic activity on the diversity of microalgae and will also be the basis of a reference resource for the screening and application of these freshwater microalgae in the future. Further studies are required on screening of potential strains of *Scenedesmus* sp. and their cultivation by using a low-cost medium for the generation of biomass.

CONCLUSION

This study revealed that the Chlorophyceae strains documented in the lakes of the Davanagere district were due to variation in nutrient inputs, which mainly influenced the abundance of *T. deserticola*. The study isolate (MZ325423) significantly showed exponential growth in FWHB and DWW wastewater by generating biomass of 1.45 gm/L, and 1.13 gm/L with 40% of lipid production. Further, the microalgae were effective in removing nutrients such as NO_3^- (58%), and PO_4^- (65%), and reduction of COD (44%) levels from wastewater. Cultivation of microalgae that utilizes agro-industrial wastes to produce value added products such as biomass and lipids is a unique approach. Hence, our results have supported the coupling of wastewater in remediation with biomass production and simultaneous utilization of biomass in generation of bioenergy and biotechnological applications.

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Table. 1: Water quality assessment in seven different lakes of Davangere district.

Sl. No	Parameters	Tolerance Limit As per ISO	Water sources						
			S1	S2	S3	S4	S5	S6	S7
			Mean± SD						
1	Temperature (°C)	30 ± 5	28.04 ± 02.0	28.50 ± 04.0	27.50 ± 02.0	27.1 ± 03.00	27.1 ± 01.00	27.55 ± 02.5	26.05 ± 03.0
2	pH	6.5 - 9.00	7.6 ± 01.5	7.9 ± 00.5	7.6 ± 00.50	7.7 ± 01.5	7.5 ± 02.00	7.6 ± 02.80	7.6 ± 01.00
3	E.C (µS/cm)	0.5 to 2500	283 ± 08.01	1242 ± 50.5	800 ± 24.5	452 ± 20.01	300 ± 10.05	190 ± 12.05	156 ± 06.00
4	Turbidity (NTU)	1	7 ± 0 3.00	15 ± 07.05	9 ± 02.04	6 ± 03.10	6 ± 2.1	4 ± 2.01	3 ± 1.2
5	DO (mg/L)	6	6.7 ± 03.00	3.3± 1.50	5.8 ± 1.4	6.5 ± 01.2	7.2 ± 01.02	7.2 ± 02.50	7.7 ± 2.01
6	BOD (mg/L)	30	4 ± 00.90	24.8 ± 4.0	9.5 ± 02.01	7.2 ± 01.4	4.5 ± 01.07	4.1 ± 01.50	3.7 ± 00.50
7	COD (mg/L)	250	18 ± 02.07	69.3 ± 22.2	43 ± 18.01	35.1 ± 04.02	22 ± 03.00	20 ± 07.00	15.3 ± 03.00
8	Calcium (mg/L)	5	48 ± 08.01	105.6 ± 10.8	86 ± 09.20	61 ± 08.07	58 ± 14.08	50 ± 10.01	46 ± 12.0
9	Magnesium (mg/L)	1	28 ± 07.01	68 ± 9.9	43 ± 07.09	37 ± 07.05	35 ± 02.90	30 ± 09.01	23 ± 09.02
10	Chloride (mg/L)	250	31 ± 04.7	121 ± 25.7	98 ± 15.02	55 ± 04.8	28 ± 03.4	24 ± 04.08	18 ± 03.00
11	Phosphate (mg/L)	10	0.56 ± 00.10	2.34 ± 0.4	1.1 ± 00.15	0.75 ± 00.19	0.22 ± 00.11	0.27 ± 00.17	0.15 ± 00.09
12	Sulphate (mg/L)	200	27 ± 03.07	75 ± 13.47	45 ± 07.09	31 ± 09.12	27 ± 03.9	21 ± 12.47	16 ± 07.00
13	Nitrate (mg/L)	10	0.64 ± 0.1	2.89 ± 1.04	1.40 ± 01.20	0.99 ± 00.19	0.39 ± 00.12	0.31 ± 00.11	0.42 ± 00.09
14	Potassium (mg/L)	5	2.1 ± 0.2	9.60 ± 0.7	3.37 ± 0.89	1.55 ± 0.8	0.97 ± 00.50	1.03 ± 0.2	0.61 ± 00.15
15	Sodium (mg/L)	50	13 ± 1.21	30 ± 3.88	20 ± 4.66	9.5 ± 3.6	5±2.28	5 ± 3.00	2 ±0.8

BOD-Biological Oxygen Demand, **COD**- Chemical Oxygen Demand, **D.O**- Dissolved Oxygen

Table. 2: Microalagal (Chlorophyceae) diversity observed in seven different lakes of Davangere district.

Sl No	Chlorophyceae	Species No	S1	S2	S3	S4	S5	S6	S7	R.A%
1)	*Actinastrum* sp.	2	1	1	1	1	2	2	0	1.9
2)	*Ankistrodesmus* sp.	5	1	1	3	2	2	1	1	2.9
3)	*Arthrodesmus* sp.	1	0	0	1	1	0	0	0	0.5
4)	*Botryococcus* sp.	1	0	0	1	0	1	0	0	0.5
5)	*Chlamydomonas* sp.	5	1	1	2	2	1	1	1	2.4
6)	*Chlorella* sp.	3	2	4	5	4	3	3	2	6.1
7)	*Chlorococcum* sp.	4	2	2	4	3	2	2	1	4.3
8)	*Closterium* sp.	6	1	1	2	1	1	1	1	2.1
9)	*Coelastrum* sp.	7	3	4	4	2	2	2	1	4.8
10)	*Coleochaete* sp.	1	1	1	0	0	0	0	0	0.5
11)	*Cosmarium* sp.	18	3	1	3	2	1	1	1	3.2
12)	*Crucigenia* sp.	1	0	1	1	0	0	0	0	0.5
13)	*Cylindrocystis* sp.	1	0	1	1	0	0	0	0	0.5
14)	*Dictyochloropsis* sp.	1	0	0	1	0	1	2	0	1.1
15)	*Dictyosphaerium* sp.	3	3	1	2	3	3	2	1	4.0
16)	*Dimorphococcus* sp.	2	1	1	2	2	1	1	0	2.1
17)	*Eremosphaera* sp.	1	1	1	1	0	0	0	0	0.8
18)	*Euastrum* sp.	2	0	0	2	1	0	0	0	0.8
19)	*Eudorina* sp.	3	1	1	3	2	1	1	0	2.4
20)	*Franceia* sp.	3	0	1	2	1	2	1	1	2.1
21)	*Golenkinia* sp.	2	1	1	2	3	2	2	1	3.2
22)	*Micractinium* sp.	4	1	1	2	4	3	3	1	4.0
23)	*Monoraphidium* sp.	1	1	0	1	1	2	2	2	2.4
24)	*Myrmecia* sp.	1	2	1	1	1	0	1	0	1.6
25)	*Nephrocytium* sp.	2	0	0	1	1	1	0	0	0.8
26)	*Oocysitis* sp.	5	2	1	2	3	3	3	1	4.0
27)	*Pandorina* sp.	2	2	2	4	3	2	2	1	4.3
28)	*Parachlorella* sp.	1	1	2	3	2	1	1	1	2.9
29)	*Pediastrum* sp.	7	1	3	5	3	3	3	1	5.1
30)	*Radiococcus* sp.	1	1	1	1	2	1	1	1	2.1
31)	*Scenedesmus* sp.	15	3	3	5	4	4	3	2	6.4
32)	*Schroederia* sp.	1	0	0	0	1	1	0	0	0.5
33)	*Selenastrum* sp.	3	2	1	1	3	2	2	1	3.2
34)	*Sphaerellopsis* sp.	1	1	0	1	1	0	0	0	0.8
35)	*Sphaerocystis* sp.	1	0	1	0	0	0	0	0	0.3
36)	*Sorastrum* sp.	3	1	2	1	1	1	1	1	2.1
37)	*Staurastrum* sp.	6	2	2	5	4	3	2	1	5.1
38)	*Tetraedron* sp.	10	2	1	3	2	2	2	1	3.5
39)	*Trochiscia* sp.	2	2	1	1	0	0	0	0	1.1
40)	*Volvox* sp.	1	0	1	1	1	0	0	0	0.8
41)	*Westella* sp.	2	1	1	2	1	1	1	0	1.9

Note: (-): 0 cells/L; (1): 1-10 cells/L; (2): 11-100 cells/L; (3): 101-1000 cells/L; (4): 1001-10000 cells/L; (5) : >10000 cells/L

Table. 3: Values of Pearson correlation studies between water sample constituents and *Scenedesmus* sp.

	Tp	pH	Td	D.O	BOD	Ak	Ca^{++}	Mg^{++}	Hd	$S\,O_4^{-}$	Cl^{-}	Na^{+}	K^{+}	No^{3-}	P^{-}	Sd Sp.
Tp	1.000															
Ph	0.794	1.000														
Td	0.584	0.833	1.000													

D.O	-0.473	-0.514	-0.769	1.000												
BOD	0.567	0.746	0.912	-0.648	1.000											
Ak	0.487	0.684	0.950	-0.886	0.898	1.000										
Ca^{++}	0.503	0.670	0.920	-0.903	0.902	0.990	1.000									
Mg^{++}	0.634	0.761	0.930	-0.762	0.974	0.924	0.937	1.000								
Hd	0.515	0.651	0.908	-0.913	0.896	0.985	0.998	0.938	1.000							
S O_4^-	0.594	0.772	0.974	-0.844	0.940	0.987	0.980	0.962	0.975	1.000						
Cl^-	0.549	0.700	0.944	-0.913	0.888	0.995	0.992	0.930	0.990	0.988	1.000					
Na^+	0.581	0.749	0.945	-0.773	0.982	0.962	0.964	0.980	0.960	0.985	0.958	1.000				
K^+	0.612	0.787	0.970	-0.787	0.972	0.966	0.962	0.983	0.957	0.993	0.965	0.995	1.000			
No^{3-}	0.550	0.640	0.888	-0.931	0.876	0.968	0.988	0.938	0.994	0.961	0.981	0.943	0.943	1.000		
P^-	0.600	0.727	0.947	-0.887	0.918	0.989	0.989	0.953	0.989	0.994	0.996	0.975	0.980	0.981	1.000	
Sd Sp.	**0.142**	0.187	0.216	**-0.627**	**-0.064**	0.276	**0.301**	**0.128**	**0.308**	0.220	0.320	0.082	0.134	**0.356**	**0.260**	1.0

Table. 4: Growth studies of microalgae in the media supplemented with different wastewater.

Sl.No	Growth Yield	BG11	Bristol	CHU	BBM	M. BG11	FWHB	DWW	CSLW
1)	(O.D Max @680nm)	1.453	1.017	1.22	1.10	1.973	1.24	1.04	0.750
2)	(Cell Dry Weight, g L^{-1})	1.334	1.007	1.152	1.104	1.673	1.124	0.905	0.612
3)	(Specific Growth rate μ, d^{-1})	0.31	0.28	0.29	0.28	0.317	0.3	0.28	0.26
4)	(Biomass Productivity , g L^{-1} d^{-1})	0.055	0.042	0.048	0.046	0.069	0.046	0.037	0.025
5)	(Lipid Productivity, g L^{-1} d^{-1})	0.0165	0.0045	0.0038	0.0047	0.0228	0.0188	0.0172	0.0028
6)	Yield %	39.6	10.7	9	11.2	54.7	45	41.3	6.7

M.BG11- Modified BG11 Media, **BBM-**Bolds Basal Media**, FWHB**-Food Waste Hydrolyzed Broth, **CSLW**-Corn Steep Liquor Waste water, **DWW-**Dairy Waste Water.

Table. 5: Nutrient removal from the Agro-Industrial waste water before and after cultivation.

Sl. No	Culture Medium	FWHB		CSLW		DWW		Removal efficiency (RE, %)		
	Parameters	Control	After cultivation	Control	After cultivation	Control	After cultivation	FWHB	CSL	DWW
1)	COD mg/L	420	210	200	110	800	500	50.00	45.00	37.50
2)	BOD^5 mg/L	160	40	50	30	210	90	75.00	40.00	57.14
3)	Sugars mg/L	342	80	300	200	490	120	76.61	33.33	75.51
4)	Nitrate mg/L	106	36	60	46	195	80	66.04	43.33	58.97
5)	Phosphate mg/L	40	10	20	10	54	15	75.00	50.00	72.22

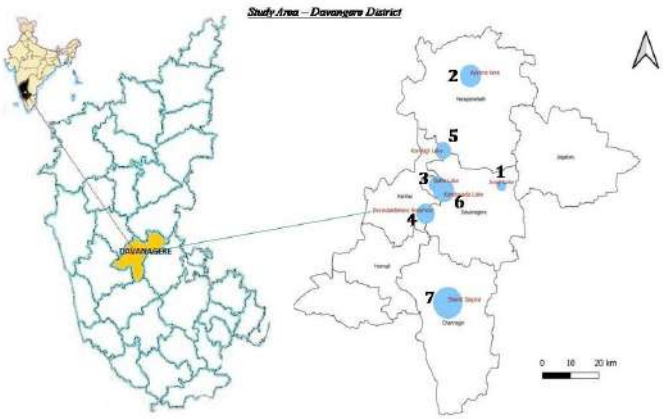

Figure: 1. Study area of Davangere District: 1.Anaji-(S1), 2.Ayyankere-(S2), 3.Bathi-(S3), 4.Kondaji-(S4), 5.Kundwada-(S5), 6.Devarabelakere-(S6) 7.Shanthisagar-(S7).

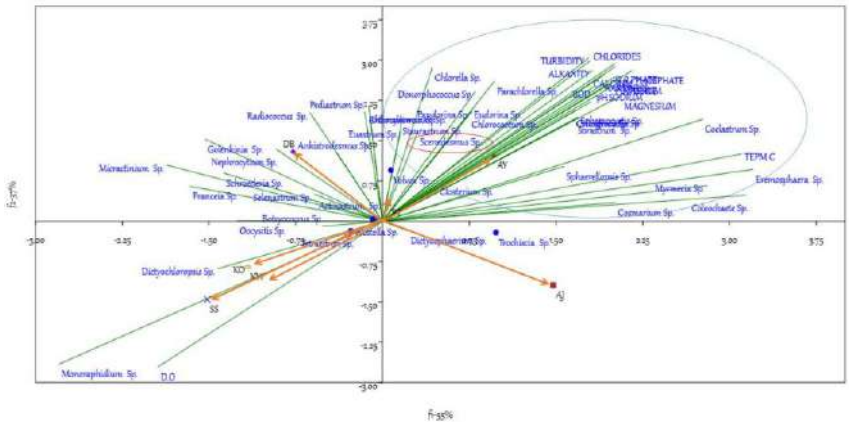

Figure: 2. Canonical correspondence analysis of Chlorophyceae diversity and water quality.

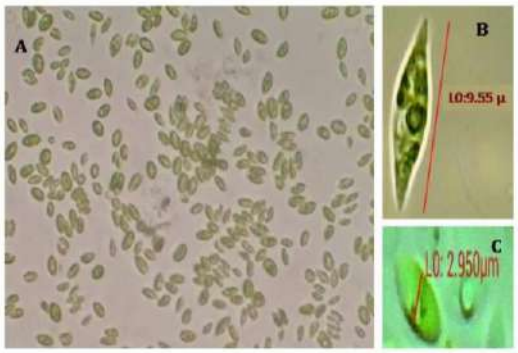

Figure: 3. Morphological determination of *T. desrticola*. A. Pure cultured cells appeared in oval shape; B and C. Cell dimensions measured.

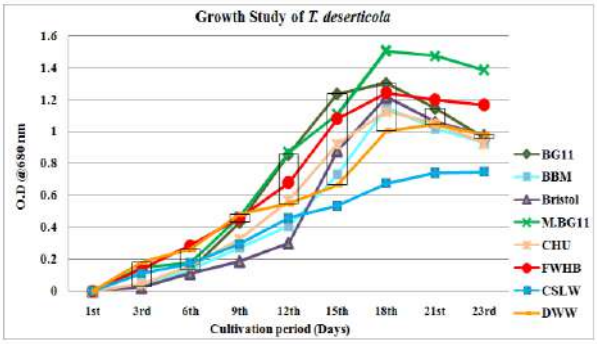

Figure: 4. Comparative Growth Study of *T. desrticola* on the media and Agro-Industrial wastewater.

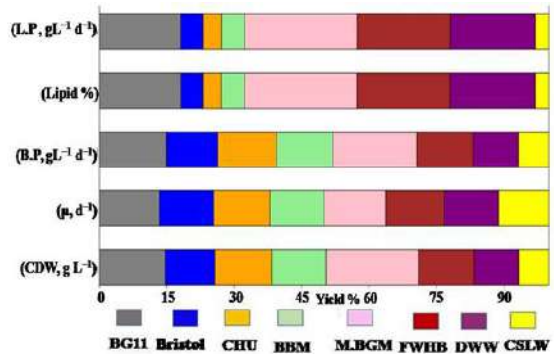

Figure: 5. Growth yield (%) of T. desrticola in the media (BG11, BST, CHU, BBM and M.BGM) and different wastewater (FWHB, DWW and CSLW).
L.P – Lipid Productivity, B.P –Biomass productivity, µ - Specific Growth rate, CDW – Cell Dry Weight.

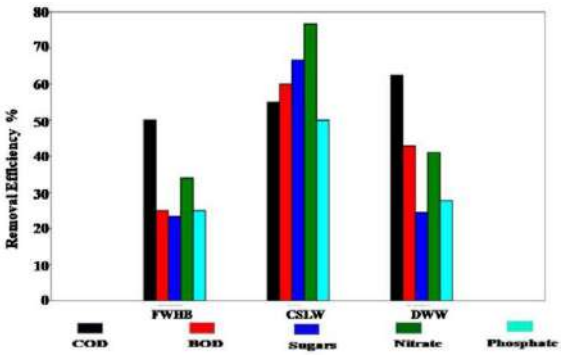

Figure: 6. Efficiency (%) of *T. desrticola* in remediation of Pollutants from wastewater.
FWHB-Food Waste Hydrolyzed Broth, CSLW-Corn Steep Liquor Waste water, DWW-Dairy Waste Water.

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RESEARCH ARTICLE

To Study the Relationship of Socio- Personal Characteristics of MGNREGS beneficiaries with their Training Needs in Dharmapuri District of Tamil Nadu

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ABSTRACT

The Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) as a job guarantee scheme, enacted by through legislations on August 25, 2005 and was implemented on February 2, 2006. This scheme aims to provide a legal guarantee for about hundred days of employment in every financial year to all adult members of any rural household willing to do public related unskilled manual work at the statutory minimum wage. This study was conducted in Pennagaram block of Dharmapuri district in ten villages where there was maximum number of MGNREGS beneficiaries. Proportionate random sampling procedure was applied to select one hundred twenty respondents from the selected panchayats with maximum MGNREGS beneficiaries. The data were collected with the help of a well structured and pre-tested interview schedule and appropriate statistical tools were used to analyse the collected data. The correlation and regression analysis revealed that out of sixteen characteristics, nine variables viz., gender, marital status, educational status, family type, family size, annual income, caste, socio- economic status and type of house showed a positive and significant relationship with training needs. All the remaing seven variables were found to be non-significant**.**

Keywords: MGNREGS, Socio- Personal characteristics, Training Needs

INTRODUCTION

In India, our GDP and unemployment rates are going together causing huge rural distress. This twin problems are strongly related and hinder the economic growth and development of our nation. To solve and overcome this

problems and deficiencies of the earlier wage employment programmes, the Government of India took a historic step by enacting the National Rural Employment Guarantee Act (NREGA) in 2005 by merging Swarnajayanthi Gram SwarojgarYojana (SGSY) and National Food for Work Programme (NFFWP) for providing livelihood security to rural unemployed. The Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) is a job guarantee scheme, enacted through legislation on August 25, 2005 and implemented on February 2, 2006. This scheme provides a legal guarantee for about hundred days of employment in every financial year to adult members of any rural household willing to do public related unskilled manual work at the statutory minimum wage. Comparison of Tamil Nadu MGNREGA statistics with the National level statistics revealed that participation of rural women workforce is more significant in Tamil Nadu. About 84.04 per cent of the beneficiaries were women in Tamil Nadu while at national level, it was 53.53 per cent. Scheduled caste community primarily involved in MGNREGA works in Tamil Nadu (29.58 per cent), whereas national level participation of SC was 20.08 per cent. Keeping this in view a study was undertaken to find out the relationship between socio- personal characteristics of MGNREGS beneficiaries with training need.

RESEARCH METHODOLOGY

The study was conducted in Pennagaram block of Dharmapuri district in selected ten villages where there was more number of MGNREGS beneficiaries. Proportionate random sampling procedure was applied to select about hundred twenty respondents from the selected panchayats. Based on judges opinion, sixteen characteristics were selected for studying the profile characteristics of the MGNREGS beneficiaries. The data were collected with the help of a well structured and pre-tested interview schedule and appropriate statistical tools were used to analyse the collected data for this research.

RESULTS AND DISCUSSION

It could be observed from the table 1, that out of sixteen independent variables Eight variables viz. Gender, Educational status, Family type, Family size, Marital status, Annual income, Socio- economic status, Type of house had significant and positive correlation with the dependent variable training need. It could be seen that family size had positive and highly significant relationship with training needs. The correlation between family size and training need indicates that with high family size they need more training to be part of this MGNREGS. With regard to gender, women beneficiaries with less education and social mobility needed training as majority are dependent on MGNREGS for their daily needs. Educational status had a positive relationship with training need. As more beneficiaries are illiterate they need more training for carrying out their routine activities in MGNREGS. Family type, Marital status, Annual income had a positive relationship with the dependent variable. Being married and a part of family, they needed training to improve their income and effectively participate in this welfare programme. Caste being a dominant social institution in rural areas and majority belonging to marginalized communities and other socially backward communities, it had a significant and positive relationship with training needs. Socio- economic status and type of house in which they reside had a significant and positive relationship at 0.1 per cent level of probability with training need. The low the social- economic status and the resultant type of housing may result in the beneficiaries actively needed training to improve their standard of living by being a part of MGNREGS.

CONCLUSION

It could be concluded from this study that, the correlation and regression analysis revealed that out of sixteen characteristics, nine variables viz., gender, marital status, educational status, family type, family size, annual income, caste, socio- economic status and type of house showed a positive and significant relationship with training needs. All the other variables were found to be non-significant. The findings of this study will be highly useful to our policy

makers to plan, accordingly and make suitable modifications and alterations in MGNREGS scheme for reaching its deserved objectives and outcomes.

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Table-1. Relationship of Socio- Personal characteristics with dependent variable (Training need)

Variable No	Independent variable	Correlation "r" Coefficient value
X_1	Age	-0.117 NS
X_2	Gender	0.239 *
X_3	Educational status	0.195 *
X_4	Family type	0.202 *
X_5	Family size	0.295 * *
X_6	Marital status	0.191 *
X_7	Annual income	0.197 *
X_8	Caste	0.253 *
X_9	Farm size	-0.102 NS
X_{10}	Socio- economic status	0.279 * *
X_{11}	Occupational status	0.60 NS
X_{12}	Social participation	0.036 NS
X_{13}	Type of House	0.259 * *
X_{14}	Farm power	0.052 NS
X_{15}	Material possession	0.156 NS
X_{16}	Economic motivation	0.060 NS

* Significant at 5 % level NS- Non significant * * Significant at 1% level

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RESEARCH ARTICLE

Direct Product on Neutrosophic Q -Fuzzy Subrings

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ABSTRACT

In this paper we deliberate about direct product. Proved theorems are imposed of direct product on Neutrosophic Q fuzzy subrings, Neutrosophic Q fuzzy ideal, and on Neutrosophic Q fuzzy normal subrings.

Keywords: Direct product, Neutrosophic Subring(NSR), Neutrosophic Q fuzzy Subring (NQFSR), Neutrosophic Q fuzzy ideal (NQFI), Neutrosophic Q fuzzy normal Subring (NQFNSR).

INTRODUCTION

Samarandache [4] expolred the conception of Neutrosophic fuzzy set which was the elongation of fuzzy set determined by L.A. Zadeh [3]. Sherwood,[6] initiated the notion of the Product of fuzzy subgroups after this fresh study on this conception was promoted by Osman [9]. Tazid Ali [5] embedded the direct product on fuzzy subrings. The contribution of Zaid's [10] idea of normal fuzzy subgroup was further extended as intutionistic normal fuzzy subring by Palaniappan [8]. The overview of product tool under intuitionisticconception was determined by Nasreen Kausar[2].

PRELIMINARIES

Definition 2.1 [7] Let R be a ring and μ be fuzzy subset (FS) of R. μ is said to be fuzzy subring of R, if it satisfies the following conditions.

$д(x - y) \geq \min\{д(x), д(y)\}$
$д(xy) \geq \min\{д(x), д(y)\}, \quad \forall\, x, y \in R.$

Definition 2.2.[7]Let R be a ring. A QFS $д$ of R is said to be a Q fuzzy subring (QFSR) of R, if it satisfies the following conditions.
$д(x - y, q) \geq \min\{д(x, q), д(y, q)\}$
$д(xy, q) \geq \min\{д(x, q), д(y, q)\}. \forall\, x, y \in R$

Definition 2.3 [4] A Neutrosophic fuzzy set(NFS) $д$ on the universe of discourse X characterized by a membership function $ʯ_д(x)$, an indeterminancy function $И_д(x)$, and non-membership function $ƒ_д(x)$ is defined as
$д = \langle x, ʯ_д(x), И_д(x), ƒ_д(x): x \in X\rangle$ where$ʯ_д, И_д, ƒ_д: X \to [0,1]$ and
$0 \leq ʯ_д(x) + И_д(x) + ƒ_д(x) \leq 3$

Definition 2.4[1] Let R be a ring. A Q FS $д$ of R is said to be a N Q FSR of R if it satisfies the following conditions:
$ʯ_д(x - y, q) \geq \min\{ʯ_д(x, q), ʯ_д(y, q)\}; ʯ_д(xy, q) \geq \min\{ʯ_д(x, q), ʯ_д(y, q)\}.$
$И_д(x - y, q) \leq \max\{И_д(x, q), И_д(y, q)\}; И_д(xy, q) \leq \max\{И_д(x, q), И_д(y, q)\}$
$ƒ_д(x - y, q) \leq \max\{ƒ_д(x, q), ƒ_д(y, q)\}; ƒ_д(xy, q) \leq \max\{ƒ_д(x, q), ƒ_д(y, q)\}$
$\forall\, x, y \in R, q \in Q.$
Where $ʯ_д, И_д, ƒ_д: X \times Q \to [0,1]$ and $0 \leq ʯ_д(x, q) + И_д(x, q) + ƒ_д(x, q) \leq 3.$

Direct product on Neutrosophic Q fuzzy subrings (NQFSR)

Definition:3. 1[11] Let$д$, $В$ be two NQFS of X and Y respectively.
Let$д$= {< ((x,q), $ʯ_{(д)}((x, q), И_{(д)}((x, q), ƒ_{(д)}((x, q)x \in X, q \in Q\}$
$В$= {<((x,q), $ʯ_{(В)}((y, q), И_{(В)}((y, q), ƒ_{(В)}((y, q)y \in Y, q \in Q\}$
Then the product is defined by $д \times В$= {<((x,y),q), $ʯ_{(д\times В)}((x,y),q), И_{(д\times В)}((x,y),q), ƒ_{(д\times В)}((x,y),q): x \in X, y \in Y, q \in Q\}$
where, $ʯ_{д\times В}((x, y), q) = \min\{ʯ_д(x, q), ʯ_В(y, q)\}; И_{д\times В}((x, y), q) = \max\{И_д(x, q), И_В(y, q)\};$
$ƒ_{д\times В}((x, y), q) = max\{ƒ_д(x, q), ƒ_В(y, q)\}; \forall\, x, y \in R, q \in Q.$
Where $ʯ_д, И_д, ƒ_д: X \times Q \to [0,1]$ and $0 \leq ʯ_д(x, q) + И_д(x, q) + ƒ_д(x, q) \leq 3.$

Definition 3.2 Let $д$, $В$ be two NQFs of a rings R_1 and R_2 respectively. Then the direct product of a NQFSR $д \times В$ of $R_1 \times R_2$ if it satisfies the following conditions:
$ʯ_{(д\times В)}[(x_1, y_1) - (x_2, y_2), q] \geq \min\{ʯ_{(д\times В)}((x_1, y_1), q), ʯ_{(д\times В)}((x_2, y_2), q)\}$
$И_{(д\times В)}[(x_1, y_1) - (x_2, y_2), q] \leq \max\{И_{(д\times В)}((x_1, y_1), q), И_{(д\times В)}((x_2, y_2), q)\}$
$ƒ_{(д\times В)}[(x_1, y_1) - (x_2, y_2), q] \leq \max\{ƒ_{(д\times В)}((x_1, y_1), q), ƒ_{(д\times В)}((x_2, y_2), q)\}$

$ʯ_{(д\times В)}[(x_1, y_1)(x_2, y_2), q] \geq \min\{ʯ_{(д\times В)}((x_1, y_1), q), ʯ_{(д\times В)}((x_2, y_2), q)\}$
$И_{(д\times В)}[(x_1, y_1)(x_2, y_2), q] \leq \max\{И_{(д\times В)}((x_1, y_1), q), И_{(д\times В)}((x_2, y_2), q)\}$
$ƒ_{(д\times В)}[(x_1, y_1)(x_2, y_2), q] \leq \max\{ƒ_{(д\times В)}((x_1, y_1), q), ƒ_{(д\times В)}((x_2, y_2), q)\}$
$\forall\, (x_1, y_1), (x_2, y_2) \in R_1 \times R_2, q \in Q$

Example:3.3 Consider the rings $(Z_2, +, \cdot)$ and $(Z_3, +, \cdot)$ and $q \in Q$ .Let $д$ and $В$ be NQFSof Z_2& Z_3 respectively defined as
$ʯ_д(0, q)=0.9$; $ʯ_д(1, q)=0.8; И_д(0, q)=0.3$; $И_д(1, q)=0.4; ƒ_д(0, q)=0.2$; $ƒ_д(1, q)=0.4;$
$ʯ_В(0, q)=0.7= ʯ_В(1, q); ʯ_В(2, q)=0.2; И_В(0, q)=И_В(1, q)=И_В(2, q)=0.4; ƒ_В(0, q)=0.1$; $ƒ_В(1, q)=ƒ_В(2, q)=0.2$ .Then $д \times В$ is a NQFSRof $Z_2 \times Z_3$.

Definition 3.4 Let $д$, $В$ be twoNQFSof a ringsR_1 and R_2 respectively. Then the direct product of a Neutrosophic$Q$ fuzzy left ideal (NQFLI)$д \times В$ of $R_1 \times R_2$ if it satisfies the following conditions

$\mu_{(A\times B)}[(x_1,y_1)-(x_2,y_2),q] \geq \min\{\mu_{(A\times B)}((x_1,y_1),q),\mu_{(A\times B)}((x_2,y_2),q)\}$
$\gamma_{(A\times B)}[(x_1,y_1)-(x_2,y_2),q] \leq \max\{\gamma_{(A\times B)}((x_1,y_1),q),\gamma_{(A\times B)}((x_2,y_2),q)\}$
$\rho_{(A\times B)}[(x_1,y_1)-(x_2,y_2),q] \leq \max\{\rho_{(A\times B)}((x_1,y_1),q),\rho_{(A\times B)}((x_2,y_2),q)\}$

$\mu_{(A\times B)}[(x_1,y_1)(x_2,y_2),q] \geq \mu_{(A\times B)}[(x_2,y_2),q]$
$\gamma_{(A\times B)}[(x_1,y_1)(x_2,y_2),q] \leq \gamma_{(A\times B)}[(x_2,y_2),q]$
$\rho_{(A\times B)}[(x_1,y_1)(x_2,y_2),q] \leq \rho_{(A\times B)}[(x_2,y_2),q]$
$\forall (x_1,y_1),(x_2,y_2) \in R_1\times R_2, q\in Q$

Definition 3.5 Let A, B be two NQFSof a rings R_1 and R_2 respectively. Then the direct product of a Neutrosophic$Q$ fuzzy right ideal(NQFRI)$A\times B$ of $R_1\times R_2$ if it satisfies the following conditions:
$\mu_{(A\times B)}[(x_1,y_1)-(x_2,y_2),q] \geq \min\{\mu_{(A\times B)}((x_1,y_1),q),\mu_{(A\times B)}((x_2,y_2),q)\}$
$\gamma_{(A\times B)}[(x_1,y_1)-(x_2,y_2),q] \leq \max\{\gamma_{(A\times B)}((x_1,y_1),q),\gamma_{(A\times B)}((x_2,y_2),q)\}$
$\rho_{(A\times B)}[(x_1,y_1)-(x_2,y_2),q] \leq \max\{\rho_{(A\times B)}((x_1,y_1),q),\rho_{(A\times B)}((x_2,y_2),q)\}$

$\mu_{(A\times B)}[(x_1,y_1)(x_2,y_2),q] \geq \mu_{(A\times B)}[(x_1,y_1),q]$
$\gamma_{(A\times B)}[(x_1,y_1)(x_2,y_2),q] \leq \gamma_{(A\times B)}[(x_1,y_1),q]$
$\rho_{(A\times B)}[(x_1,y_1)(x_2,y_2),q] \leq \rho_{(A\times B)}[(x_1,y_1),q]$
$\forall (x_1,y_1),(x_2,y_2) \in R_1\times R_2, q\in Q$

Definition 3.6 Let A, B be twoNQFSof a rings R_1 and R_2 respectively. Then the direct product of a NQFI $A\times B$ of $R_1\times R_2$ if it satisfies the following conditions:
$\mu_{(A\times B)}[(x_1,y_1)-(x_2,y_2),q] \geq \min\{\mu_{(A\times B)}((x_1,y_1),q),\mu_{(A\times B)}((x_2,y_2),q)\}$
$\gamma_{(A\times B)}[(x_1,y_1)-(x_2,y_2),q] \leq \max\{\gamma_{(A\times B)}((x_1,y_1),q),\gamma_{(A\times B)}((x_2,y_2),q)\}$
$\rho_{(A\times B)}[(x_1,y_1)-(x_2,y_2),q] \leq \max\{\rho_{(A\times B)}((x_1,y_1),q),\rho_{(A\times B)}((x_2,y_2),q)\}$

$\mu_{(A\times B)}[(x_1,y_1)(x_2,y_2),q] \geq \max\{\mu_{(A\times B)}((x_1,y_1),q),\mu_{(A\times B)}((x_2,y_2),q)\}$
$\gamma_{(A\times B)}[(x_1,y_1)(x_2,y_2),q] \leq \min\{\gamma_{(A\times B)}((x_1,y_1),q),\gamma_{(A\times B)}((x_2,y_2),q)\}$
$\rho_{(A\times B)}[(x_1,y_1)(x_2,y_2),q] \leq \min\{\rho_{(A\times B)}((x_1,y_1),q),\rho_{(A\times B)}((x_2,y_2),q)\}$
$\forall (x_1,y_1),(x_2,y_2) \in R_1\times R_2, q\in Q$

Example:3.7 Let $(Z_2,+,\cdot)$be a ring and $q\in Q$ .consider $Z_2\times Z_2$={(0,0),(0,1)(1,0),(1,1)} Define a NQFSA and B of $Z_2\times Z_2$ respectively defined as
$\mu_A(0,q)$=0.9; $\mu_A(1,q)$=0.7;$\gamma_A(0,q)$=0.3;$\gamma_A(1,q)$=0.4;$\rho_A(0,q)$=0.4 ;$\rho_A(1,q)$=0.6; $\mu_B(0,q)$=0.8
$\mu_B(1,q)$=0.5;$\gamma_B(0,q)$=0.3; $\gamma_B(1,q)=0.4$;$\rho_B(0,q)$=0.4;$\rho_B(1,q)$=0.5. Then $A\times B$ is a NQFI of $Z_2\times Z_2$.

Theorem.**3.8**Let $R_1$and R_2 be two rings. If A and B be a QFS of $R_1$and R_2 respectively. If $A\times B$ is a NQFSR of $R_1\times R_2$ then
$\mu_{(A\times B)}\left((e,e'),q\right) \geq \mu_{(A\times B)}((x,y),q)$;$\gamma_{(A\times B)}\left((e,e'),q\right) \leq \gamma_{(A\times B)}((x,y),q)$
$\rho_{(A\times B)}\left((e,e'),q\right) \leq \rho_{(A\times B)}((x,y),q)$; for all$(x,y)\in R_1\times R_2$ and $q\in Q$ hold.
Proof: Let $A\times B$ is a NQFSRof $R_1\times R_2$
$\mu_{(A\times B)}\left((e,e'),q\right)=\mu_{(A\times B)}((x-x),(y-y),q)=\mu_{(A\times B)}((x,y)-(x,y),q)$
$\geq \min\{\mu_{(A\times B)}((x,y),q),\mu_{(A\times B)}((x,y),q)\}\geq \mu_{(A\times B)}((x,y),q)$
$\gamma_{(A\times B)}\left((e,e'),q\right)=\mu_{(A\times B)}((x-x),(y-y),q)=\mu_{(A\times B)}((x,y)-(x,y),q)$
$\leq \max\{\mu_{(A\times B)}((x,y),q),\mu_{(A\times B)}((x,y),q)\}\leq \mu_{(A\times B)}((x,y),q)$
Similarly,$\rho_{(A\times B)}\left((e,e'),q\right)\leq \rho_{(A\times B)}((x,y),q)$.Hence the theorem.

Remark: 3.9 However, if $\mathcal{A}$ and $\mathcal{B}$ be NQFS of $R_1$and R_2 respectively such that $\mu_{(\mathcal{A}\times\mathcal{B})}\left((e,e'),q\right) \geq \mu_{(\mathcal{A}\times\mathcal{B})}((x,y),\ q)$;$I_{(\mathcal{A}\times\mathcal{B})}\left((e,e'),q\right) \leq I_{(\mathcal{A}\times\mathcal{B})}((x,y),\ q)$ $\gamma_{(\mathcal{A}\times\mathcal{B})}\left((e,e'),q\right) \leq \gamma_{(\mathcal{A}\times\mathcal{B})}((x,y),\ q)$exist then, at that point, it isn't really a fact that $\mathcal{A}\times\mathcal{B}$ is a NQFSR of $R_1\times R_2$ as is obvious from the accompanying case.

Example: 3.10 Consider the ring $(Z_3,+,\cdot)$and $q\in Q$ .Let $\mathcal{A}$ and $\mathcal{B}$ be NQFSof Z_3. Defined as $\mu_{\mathcal{A}}(0,q)=0.8$; $\mu_{\mathcal{A}}(1,q)=0.5$; $\mu_{\mathcal{A}}(2,q)=0.7$$I_{\mathcal{A}}(0,q)=0.1$;$I_{\mathcal{A}}(1,q)=0.3$;$I_{\mathcal{A}}(2,q)=0.6$;$\gamma_{\mathcal{A}}(0,q)=0.4$$\gamma_{\mathcal{A}}(1,q)=0.6=\gamma_{\mathcal{A}}(2,q)$; $\mu_{\mathcal{B}}(0,q)=0.6$; $\mu_{\mathcal{B}}(1,q)=0.4$; $\mu_{\mathcal{B}}(2,q)=0.2$;$I_{\mathcal{B}}(0,q)=0.1$; $I_{\mathcal{B}}(1,q)=0.2$;$I_{\mathcal{B}}(2,q)=0.5$; $\gamma_{\mathcal{B}}(0,q)=0.4$;$\gamma_{\mathcal{B}}(1,q)=0.5=\gamma_{\mathcal{B}}(2,q)$.Then it is clear that $\mu_{(\mathcal{A}\times\mathcal{B})}\left((e,e'),q\right) \geq \mu_{(\mathcal{A}\times\mathcal{B})}((x,y),\ q)$;$I_{(\mathcal{A}\times\mathcal{B})}\left((e,e'),q\right) \leq I_{(\mathcal{A}\times\mathcal{B})}((x,y),\ q)$ $\gamma_{(\mathcal{A}\times\mathcal{B})}\left((e,e'),q\right) \geq \gamma_{(\mathcal{A}\times\mathcal{B})}((x,y),\ q)$hold. But $\mathcal{A}\times\mathcal{B}$ is not a NQFSR of $Z_3\times Z_3$ as $\mu_{(\mathcal{A}\times\mathcal{B})}[(0,2)-(2,0),q]$=0.2 and $\min\{\mu_{(\mathcal{A}\times\mathcal{B})}((0,2),q),\mu_{(\mathcal{A}\times\mathcal{B})}((2,0),q)\}$=0.3 and hence $\mu_{(\mathcal{A}\times\mathcal{B})}[(0,2)-(2,0),q] \not\geq \min\{\mu_{(\mathcal{A}\times\mathcal{B})}((0,2),q),\mu_{(\mathcal{A}\times\mathcal{B})}((2,0),q)\}$.

Theorem.3.11. Let$\mathcal{A}$and $\mathcal{B}$ be QFSof rings R_1 and R_2respectively then $\mathcal{A}\times\mathcal{B}$be a N$Q$FSRof $R_1\times R_2$.

Proof: Let $(x_1,y_1)(x_2,y_2)\in R_1\times R_2$, $q\in Q$.

Now, $\mu_{(\mathcal{A}\times\mathcal{B})}[(x_1,y_1)-(x_2,y_2),q] = \mu_{(\mathcal{A}\times\mathcal{B})}\left((x_1-x_2),(y_1-y_2),q\right)$

$=\min\{\mu_{\mathcal{A}}((x_1-x_2),q),\ \mu_{\mathcal{B}}(y_1-y_2),q)\} \geq \min\begin{Bmatrix}\min\{\mu_{\mathcal{A}}(x_1,q),\mu_{\mathcal{A}}(x_2,q)\}\\ \min\{(\mu_{\mathcal{B}}(y_1,q),\ \mu_{\mathcal{B}}(y_2,q)\}\end{Bmatrix} \geq \min\begin{Bmatrix}\min\{\mu_{\mathcal{A}}(x_1,q),(\mu_{\mathcal{B}}(y_1,q)\}\\ \min\{\mu_{\mathcal{A}}(x_2,q),\ \mu_{\mathcal{B}}(y_2,q)\}\end{Bmatrix} \geq$

$\min\{\mu_{(\mathcal{A}\times\mathcal{B})}((x_1,y_1),q),\mu_{(\mathcal{A}\times\mathcal{B})}((x_2,y_2),q)\}$.

$I_{(\mathcal{A}\times\mathcal{B})}[(x_1,y_1)-(x_2,y_2),q] = I_{(\mathcal{A}\times\mathcal{B})}\left((x_1-x_2),(y_1-y_2),q\right)=\max\{I_{\mathcal{A}}((x_1-x_2),q),I_{\mathcal{B}}(y_1-y_2),q)\} \leq \max$

$\begin{Bmatrix}\max\{I_{\mathcal{A}}(x_1,q),I_{\mathcal{A}}(x_2,q)\}\\ \max\{(I_{\mathcal{B}}(y_1,q),I_{\mathcal{B}}(y_2,q)\}\end{Bmatrix} \leq \max\begin{Bmatrix}\max\{I_{\mathcal{A}}(x_1,q),(I_{\mathcal{B}}(y_1,q)\}\\ \max\{I_{\mathcal{A}}(x_2,q),I_{\mathcal{B}}(y_2,q)\}\end{Bmatrix} \leq \max\{I_{(\mathcal{A}\times\mathcal{B})}((x_1,y_1),q),I_{(\mathcal{A}\times\mathcal{B})}((x_2,y_2),q)\}$.

Similarly,$\gamma_{(\mathcal{A}\times\mathcal{B})}[(x_1,y_1)-(x_2,y_2),q] \leq \max\{\gamma_{(\mathcal{A}\times\mathcal{B})}((x_1,y_1),q),\gamma_{(\mathcal{A}\times\mathcal{B})}((x_2,y_2),q)\}$

Also, $\mu_{(\mathcal{A}\times\mathcal{B})}[(x_1,y_1)(x_2,y_2),q] = \mu_{(\mathcal{A}\times\mathcal{B})}\left((x_1x_2),(y_1y_2),q\right)=\min\{\mu_{\mathcal{A}}((x_1x_2),q),\ \mu_{\mathcal{B}}(y_1y_2),q)\} \geq$

$\min\begin{Bmatrix}\min\{\mu_{\mathcal{A}}(x_1,q),\mu_{\mathcal{A}}(x_2,q)\}\\ \min\{(\mu_{\mathcal{B}}(y_1,q),\ \mu_{\mathcal{B}}(y_2,q)\}\end{Bmatrix} \geq \min\begin{Bmatrix}\min\{\mu_{\mathcal{A}}(x_1,q),(\mu_{\mathcal{B}}(y_1,q)\}\\ \min\{\mu_{\mathcal{A}}(x_2,q),\ \mu_{\mathcal{B}}(y_2,q)\}\end{Bmatrix} \geq \min\{\mu_{(\mathcal{A}\times\mathcal{B})}((x_1,y_1),q),\mu_{(\mathcal{A}\times\mathcal{B})}((x_2,y_2),q)\}$.

$I_{(\mathcal{A}\times\mathcal{B})}[(x_1,y_1)(x_2,y_2),q] = I_{(\mathcal{A}\times\mathcal{B})}\left((x_1x_2),(y_1y_2),q\right)=\max\{I_{\mathcal{A}}((x_1x_2),q),I_{\mathcal{B}}(y_1y_2),q)\} \leq$

$\max\begin{Bmatrix}\max\{I_{\mathcal{A}}(x_1,q),I_{\mathcal{A}}(x_2,q)\}\\ \max\{(I_{\mathcal{B}}(y_1,q),I_{\mathcal{B}}(y_2,q)\}\end{Bmatrix} \leq \max$

$\begin{Bmatrix}\max\{I_{\mathcal{A}}(x_1,q),(I_{\mathcal{B}}(y_1,q)\}\\ \max\{I_{\mathcal{A}}(x_2,q),I_{\mathcal{B}}(y_2,q)\}\end{Bmatrix} \leq \max\{I_{(\mathcal{A}\times\mathcal{B})}((x_1,y_1),q),I_{(\mathcal{A}\times\mathcal{B})}((x_2,y_2),q)\}$.

Similarly,$\gamma_{(\mathcal{A}\times\mathcal{B})}[(x_1,y_1)(x_2,y_2),q] \leq \max\{\gamma_{(\mathcal{A}\times\mathcal{B})}((x_1,y_1),q),\gamma_{(\mathcal{A}\times\mathcal{B})}((x_2,y_2),q)\}$.

Hence$\mathcal{A}\times\mathcal{B}$is a N$Q$FS of $R_1\times R_2$.

Theorem.3.12. Let$\mathcal{A}$and $\mathcal{B}$ be NQFL(R)I of the rings R_1 and R_2 respectively then $\mathcal{A}\times\mathcal{B}$be a N$Q$FL(R)Iof $R_1\times R_2$.

Proof: Let$\mathcal{A}$and $\mathcal{B}$ be NQFLI of R_1 and R_2respectively and $(x_1,y_1)(x_2,y_2)\in R_1\times R_2$, $q\in Q$.

Now, $\mu_{(\mathcal{A}\times\mathcal{B})}[(x_1,y_1)(x_2,y_2),q] = \mu_{(\mathcal{A}\times\mathcal{B})}\left((x_1x_2,y_1y_2),q\right)$

$=\min\{\mu_{\mathcal{A}}((x_1x_2,q),\ \mu_{\mathcal{B}}(y_1y_2,q)\} \geq \min\{\mu_{\mathcal{A}}(x_2,q),\mu_{\mathcal{B}}(y_2,q)\}=\mu_{(\mathcal{A}\times\mathcal{B})}[(x_2,y_2),q]$

$I_{(\mathcal{A}\times\mathcal{B})}[(x_1,y_1)(x_2,y_2),q] = I_{(\mathcal{A}\times\mathcal{B})}((x_1x_2,y_1y_2),q) \leq \max\{I_{\mathcal{A}}((x_1x_2,q),\ I_{\mathcal{B}}(y_1y_2,q)\} \leq$

$\max\{I_{\mathcal{A}}(x_2,q),I_{\mathcal{B}}(y_2,q)\}=I_{(\mathcal{A}\times\mathcal{B})}[(x_2,y_2),q]$

Similarly,$\gamma_{(\mathcal{A}\times\mathcal{B})}[(x_1,y_1)(x_2,y_2),q] \leq \gamma_{(\mathcal{A}\times\mathcal{B})}[(x_2,y_2),q]$.Hence$\mathcal{A}\times\mathcal{B}$is a N$Q$FLIof $R_1\times R_2$ .Similarly we can show that $\mathcal{A}\times\mathcal{B}$ is a NQFRIof $R_1\times R_2$.

Theorem.3.13. Let $\mathcal{A}$ and $\mathcal{B}$ be NQFI of the rings R_1 and R_2 respectively then $\mathcal{A} \times \mathcal{B}$ be a NQFI of $R_1 \times R_2$.
Proof. Follows from the above theorem

Theorem.3.14. Let $\mathcal{A}$ and $\mathcal{B}$ be NFSof ring R_1 and R_2 respectively. If $\mathcal{A} \times \mathcal{B}$is a N$Q$FSRof $R_1 \times R_2$. Then at least one of the following two statement must hold.
(i) $\mu_{\mathcal{B}}(e', q) \geq \mu_{\mathcal{A}}(x, q); \nu_{\mathcal{B}}(e', q) \leq \nu_{\mathcal{A}}(x, q); \gamma_{\mathcal{B}}(e', q) \leq \gamma_{\mathcal{A}}(x, q)$
(ii) $\mu_{\mathcal{A}}(e, q) \geq \mu_{\mathcal{B}}(y, q); \nu_{\mathcal{A}}(e, q) \leq \nu_{\mathcal{B}}(y, q); \gamma_{\mathcal{A}}(e, q) \leq \gamma_{\mathcal{B}}(y, q);$ $(x, y) \in R_1 \times R_2$ and $q \in Q$.
Proof: Let $\mathcal{A} \times \mathcal{B}$ be a NQFSR of $R_1 \times R_2$ .Instead of having intension of achieving those, we consider contrariety, $\mu_{\mathcal{B}}(e', q) \leq \mu_{\mathcal{A}}(x, q); \nu_{\mathcal{B}}(e', q) \geq \nu_{\mathcal{A}}(x, q); \gamma_{\mathcal{B}}(e', q) \geq \gamma_{\mathcal{A}}(x, q)$
$\mu_{\mathcal{A}}(e, q) \leq \mu_{\mathcal{B}}(y, q); \nu_{\mathcal{A}}(e, q) \geq \nu_{\mathcal{B}}(y, q); \gamma_{\mathcal{A}}(e, q) \geq \gamma_{\mathcal{B}}(y, q)$.
Thus we have,
$\mu_{(\mathcal{A} \times \mathcal{B})}[(x, y), q] = \min\{\mu_{\mathcal{A}}(x, q), \mu_{\mathcal{B}}(y, q)\} > \min\{\mu_{\mathcal{A}}(e, q), \mu_{\mathcal{B}}(e', q)\} = \mu_{(\mathcal{A} \times \mathcal{B})}((e, e'), q)$
$\nu_{(\mathcal{A} \times \mathcal{B})}[(x, y), q] = \max\{\nu_{\mathcal{A}}(x, q), \nu_{\mathcal{B}}(y, q)\} < \max\{\nu_{\mathcal{A}}(e, q), \nu_{\mathcal{B}}(e', q)\} = \nu_{(\mathcal{A} \times \mathcal{B})}((e, e'), q)$
Similarly, $\gamma_{(\mathcal{A} \times \mathcal{B})}[(x, y), q] < \gamma_{(\mathcal{A} \times \mathcal{B})}\left((e, e'), q\right)$.Which is contradict to the theorem 3.8. Hence our assumption is wrong. Hence (i) holds.

Remark:3.15 However, if $\mathcal{A}$ and $\mathcal{B}$ be NQFS of R_1 and R_2 respectively such thatone of the following condition hold
(i) $\mu_{\mathcal{B}}(e', q) \geq \mu_{\mathcal{A}}(x, q); \nu_{\mathcal{B}}(e', q) \leq \nu_{\mathcal{A}}(x, q); \gamma_{\mathcal{B}}(e', q) \leq \gamma_{\mathcal{A}}(x, q)$
(ii) $\mu_{\mathcal{A}}(e, q) \geq \mu_{\mathcal{B}}(y, q); \nu_{\mathcal{A}}(e, q) \leq \nu_{\mathcal{B}}(y, q); \gamma_{\mathcal{A}}(e, q) \leq \gamma_{\mathcal{B}}(y, q)$ then it is not necessarily true that $\mathcal{A} \times \mathcal{B}$ is a NQFSR of $R_1 \times R_2$ as is evident from the following example.

Example:3.16 Consider the ring $(Z_4, +, \cdot)$and $(Z_3, +, \cdot)$& $q \in Q$ .Let $\mathcal{A}$ and $\mathcal{B}$ be NQFS of Z_4 and Z_3 respectively defined as,
$\mu_{\mathcal{A}}(0, q) = 0.7; \mu_{\mathcal{A}}(1, q) = 0.4; \mu_{\mathcal{A}}(2, q) = 0.2 = \mu_{\mathcal{A}}(3, q); \nu_{\mathcal{A}}(0, q) = 0.1; \nu_{\mathcal{A}}(1, q) = 0.6; \nu_{\mathcal{A}}(2, q) = 0;$
$\nu_{\mathcal{A}}(3, q) = 0.4$; $\gamma_{\mathcal{A}}(0, q) = 0.4; \gamma_{\mathcal{A}}(0, q) = 0.2; \gamma_{\mathcal{A}}(1, q) = 0.3; \gamma_{\mathcal{A}}(2, q) = 0.5 = \gamma_{\mathcal{A}}(3, q);$
$\mu_{\mathcal{B}}(0, q) = 0.6; \mu_{\mathcal{B}}(1, q) = 0.5 = \mu_{\mathcal{B}}(2, q); \nu_{\mathcal{B}}(0, q) = 0.2; \nu_{\mathcal{B}}(1, q) = 0.3 = \nu_{\mathcal{B}}(2, q); \gamma_{\mathcal{B}}(0, q) = 0.3; \gamma_{\mathcal{B}}(1, q) = 0.5 = \gamma_{\mathcal{B}}(2, q)$.Then it is clear that $\mu_{\mathcal{A}}(e, q) \geq \mu_{\mathcal{B}}(y, q); \nu_{\mathcal{A}}(e, q) \leq \nu_{\mathcal{B}}(y, q); \gamma_{\mathcal{A}}(e, q) \leq \gamma_{\mathcal{B}}(y, q)$ hold. But $\mathcal{A} \times \mathcal{B}$is not a N$Q$FSR of $Z_4 \times Z_3$ as $\nu_{(\mathcal{A} \times \mathcal{B})}[(2,0) - (3,0), q] = 0.6; \max\{\nu_{(\mathcal{A} \times \mathcal{B})}((x_1, y_1), q), \nu_{(\mathcal{A} \times \mathcal{B})}((x_2, y_2), q)\} = 0.4$ and hence
$_{(\mathcal{A} \times \mathcal{B})}[(\nu x_1, y_1) - (x_2, y_2), q] \not\leq \max\{\nu_{(\mathcal{A} \times \mathcal{B})}((x_1, y_1), q), \nu_{(\mathcal{A} \times \mathcal{B})}((x_2, y_2), q)\}$

Theorem.3.17. Let $\mathcal{A}$ and $\mathcal{B}$ be a QFS of rings R_1 and R_2 respectively.If $\mathcal{A} \times \mathcal{B}$ is a NQFSRof $R_1 \times R_2$ then either $\mathcal{A}$ is a NQFSR of R_1 or$\mathcal{B}$ is a NQFSR of R_2.
Proof. If $\mathcal{A} \times \mathcal{B}$ is a NQFSR of $R_1 \times R_2$. The by the above theorem eqn (1) hold
$\mu_{\mathcal{A}}(x - y, q) = \min\{\mu_{\mathcal{A}}(x - y, q), \mu_{\mathcal{B}}((e' - e'), q)\} = \mu_{(\mathcal{A} \times \mathcal{B})}\left((x - y, q), \left((e' - e')\right), q\right)$
$= \mu_{(\mathcal{A} \times \mathcal{B})}\left(((x, e'), q) - ((y, e'), q)\right) \geq min\left\{\mu_{(\mathcal{A} \times \mathcal{B})}\left(((x, e'), q), \mu_{(\mathcal{A} \times \mathcal{B})}\left((y, e')\right), q\right)\right\}$
$= \min\begin{Bmatrix} \min\{\mu_{\mathcal{A}}(x, q), \mu_{\mathcal{B}}(e', q)\} \\ \min\{(\mu_{\mathcal{A}}(y, q), \mu_{\mathcal{B}}(e', q)\} \end{Bmatrix} \geq min\{\mu_{\mathcal{A}}(x, q), \mu_{\mathcal{A}}(y, q)\}$
$\nu_{\mathcal{A}}(x - y, q) = \max\{\nu_{\mathcal{A}}(x - y), q), \nu_{\mathcal{B}}((e' - e'), q)\} = \nu_{(\mathcal{A} \times \mathcal{B})}\left((x - y, q), \left((e' - e')\right), q\right)$
$= \nu_{(\mathcal{A} \times \mathcal{B})}(((x, e'), q) - ((y, e')), q) \leq \max\{\nu_{(\mathcal{A} \times \mathcal{B})}(((x, e'), q), \nu_{(\mathcal{A} \times \mathcal{B})}((y, e')), q)\}$
$= \max\begin{Bmatrix} \max\{\nu_{\mathcal{A}}(x, q), \nu_{\mathcal{B}}(e', q)\} \\ \max\{(\nu_{\mathcal{A}}(y, q), \nu_{\mathcal{B}}(e', q)\} \end{Bmatrix} \leq \max\{\nu_{\mathcal{A}}(x, q), \nu_{\mathcal{A}}(y, q)\}$
Similarly, $\gamma_{\mathcal{A}}(x - y, q) \leq \max\{\gamma_{\mathcal{A}}(x, q), \gamma_{\mathcal{A}}(y, q)\}$.
$\mu_{\mathcal{A}}(xy, q) = \min\{\mu_{\mathcal{A}}(xy, q), \mu_{\mathcal{B}}((e'e'), q)\} = \mu_{(\mathcal{A} \times \mathcal{B})}\left((xy, q), ((e'e')), q\right)$
$= \mu_{(\mathcal{A} \times \mathcal{B})}\left(((x, e'), q)\left((y, e')\right), q\right) \geq \min\left\{\mu_{(\mathcal{A} \times \mathcal{B})}\left(((x, e'), q), \mu_{(\mathcal{A} \times \mathcal{B})}\left((y, e')\right), q\right)\right\}$
$= \min\begin{Bmatrix} \min\{\mu_{\mathcal{A}}(x, q), \mu_{\mathcal{B}}(e', q)\} \\ \min\{(\mu_{\mathcal{A}}(y, q), \mu_{\mathcal{B}}(e', q)\} \end{Bmatrix} \geq \min\{\mu_{\mathcal{A}}(x, q), \mu_{\mathcal{A}}(y, q)\}$

$И_{д}(xy', q) = \max\{И_{д}(xy'), q), И_{в}((e'e'), q)\}$=$И_{(д\times в)}\left((xy', q), ((e'e')), q\right)$
=$И_{(д\times в)}(((x, e'), q)((y', e')), q) \leq \max\{И_{(д\times в)}(((x, e'), q), И_{(д\times в)}((y', e')), q)\}$
=$\max\begin{Bmatrix} \max\{И_{д}(x, q),\ И_{в}(e', q)\} \\ \max\{(\ И_{д}(y', q),\ И_{в}(e', q)\} \end{Bmatrix} \leq \max\{И_{д}(x, q), И_{д}(y', q)\}$
Similarly,$ғ_{д}(xy', q) \leq \max\{ғ_{д}(x, q), ғ_{д}(y', q)\}$.Hence $д$ is a NQFSR of R_1. Follow the same way we can find $в$ is a NQFSR of R_2.

Theorem.3.18. Let$д$ and $в$ be a QFS of $R_1$and R_2 respectively.If $д \times в$ is a NQFL(R)Iof $R_1 \times R_2$ then either $д$ is a N-QFL(R)I of R_1or$в$ is a NQFL(R)I of R_2.
Proof. If $д \times в$ is a NQFSRof $R_1 \times R_2$. In the view of above theorem it is enough to show that, $м_{д}(xy', q) \geq м_{д}(y', q)$;$И_{д}(xy', q) \leq И_{д}(y', q)$; $ғ_{д}(xy', q) \leq ғ_{д}(y', q)$
$\forall x, y' \in R, q \in Q$.
$м_{д}(xy', q) = \min\{м_{д}(xy', q), м_{в}((e'e'), q)\}$=$м_{(д\times в)}\left((xy', q), ((e'e')), q\right)$
=$м_{(д\times в)}(((x, e'), q)((y', e')), q) \geq м_{(д\times в)}((y', e'), q) \geq \min\{м_{д}(y', q), м_{д}(e', q)\} \geq м_{д}(y', q)$
$И_{д}(xy', q) = \min\{И_{д}(xy', q), И_{в}((e'e'), q)\}$=$И_{(д\times в)}\left((xy', q), ((e'e')), q\right)$
=$И_{(д\times в)}(((x, e'), q)((y', e')), q) \leq И_{(д\times в)}((y', e'), q) \leq \max\{И_{д}(y', q), И_{д}(e', q)\} \leq И_{д}(y', q)$
Similarly,$ғ_{д}(xy', q) \leq ғ_{д}(y', q)$.Hence $д$ is a NQFLIof R_1. Follow the same way we can find $в$ is a NQFRI of R_2.

Theorem.3.19. Let$д$ and $в$ be a QFş of $R_1$and R_2 respectively.If $д \times в$ is a NQFI of $R_1 \times R_2$ then either $д$ is a NQFIof R_1or $в$ is a NQFIof R_2.
Proof. Follows from the above theorem.

Remark:3.20 If either $д$or$в$ is a NQFSR(NQFI) R_1 and R_2respectively then, at that point, it isn't really a fact $д \times в$ is a NQFSR(NQFI) of $R_1 \times R_2$ that as is obvious from the accompanying case.

Example:3.21 Consider the ring (Z_4 , +,·)and (Z_2 , +,·)&$q \in Q$ .Let $д$ and $в$ be N QFS of
Z_4 and Z_2 respectively defined as
$м_{д}(0, q)$=0.8; $м_{д}(1, q)$=0.7; $м_{д}(2, q)$=0.5= $м_{д}(3, q) = 0.9$; $И_{д}(0, q)$=0.1;$И_{д}(1, q)$=0.3;$И_{д}(2, q)$=0.6;
$И_{д}(3, q) = 0.6$; $ғ_{д}(0, q)$=0.5; $ғ_{д}(1, q)$=0.7; $ғ_{д}(2, q)$=0.7; = $ғ_{д}(3, q)$
$м_{в}(0, q)$=0.9; $м_{в}(1, q)$=0.7;$И_{в}(0, q)$=0.1; $И_{в}(1, q) = 0.2$; $ғ_{в}(0, q)$=0.5;$ғ_{в}(1, q)$=0.7.It is clear that if either $д$ or $в$ is a NQFSR(ideal) Z_4 and Z_2 respectively then it is not necessarily true that $д \times в$ is not a NQFSR(ideal) of $Z_4 \times Z_2$as
$м_{(д\times в)}[(3,1) - (1,1), q]$=0.5 and $\min\{м_{(д\times в)}((0,2), q), м_{(д\times в)}((2,0), q)\}$=0.7 and hence
$м_{(д\times в)}[(3,1) - (1,1), q] \not\geq \min\{м_{(д\times в)}((0,2), q), м_{(д\times в)}((2,0), q)\}$.

Direct product on Neutrosophic Q fuzzy normal subring
Definition 4.1.
A NQFNŞSRof $R_1 \times R_2$ is said to be NQFŃSRof $R_1 \times R_2$ if
$м_{(д\times в)}[(x_1, y_1)(x_2, y_2), q] = м_{(д\times в)}\left((x_2, y_2), (x_1, y_1), q\right)$
$И_{(д\times в)}[(x_1, y_1)(x_2, y_2), q] = И_{(д\times в)}\left((x_2, y_2), (x_1, y_1), q\right)$
$ғ_{(д\times в)}[(x_1, y_1)(x_2, y_2), q] = ғ_{(д\times в)}\left((x_2, y_2), (x_1, y_1), q\right)$
$\forall \left(x_{1,} x_2\right)(y_1, y_2) \in R_1 \times R_2, q \in Q$.

Theorem.4.2. Let$д$and $в$ be NQFS of $R_1$and R_2 respectively. If $д \times в$ is a NQFNŞSR of $R_1 \times R_2$. Then at least one of the following two statement must hold. If
$м_{в}(e', q) \geq м_{д}(x, q)$;$И_{в}(e', q) \leq И_{д}(x, q)$; $ғ_{в}(e', q) \leq ғ_{д}(x, q)$
$м_{д}(e, q) \geq м_{в}(y', q)$;$И_{д}(e, q) \leq И_{в}(y', q)$; $ғ_{д}(e, q) \leq ғ_{в}(y', q)$; holds for$(x, y') \in R_1 \times R_2$ and $q \in Q$ then either $д$ is NQFNŞSR of R_1 or $в$ is NQFNŞSR of R_2.

Proof: In theorem 3.17 we proved that either $\mathcal{A}$ or $\mathcal{B}$ is NQFSRof R_1 and R_2 respectively. It is enough to prove the normality only.

Now, $\mu_{\mathcal{A}}(xy,q) = \min\{\mu_{\mathcal{A}}(xy,q), \mu_{\mathcal{B}}((e'e'),q)\} = \mu_{(\mathcal{A}\times\mathcal{B})}((xy,e'e'),q))$

$= \mu_{(\mathcal{A}\times\mathcal{B})}\left(((x,e'),q)\left((y,e')\right),q\right) = \mu_{(\mathcal{A}\times\mathcal{B})}\left(((y,e'),q)\left((x,e')\right),q\right) = \mu_{(\mathcal{A}\times\mathcal{B})}\left((yx,e'e'),q\right)$

$= \min\{\mu_{\mathcal{A}}(yx,q), \mu_{\mathcal{B}}((e'e'),q)\} = \mu_{\mathcal{A}}(yx,q)$

$I_{\mathcal{A}}(xy,q) = \max\{I_{\mathcal{A}}(xy,q), I_{\mathcal{B}}((e'e'),q)\} = I_{(\mathcal{A}\times\mathcal{B})}((xy,e'e'),q))$

$= I_{(\mathcal{A}\times\mathcal{B})}(((x,e'),q)((y,e')),q) = I_{(\mathcal{A}\times\mathcal{B})}(((y,e'),q)((x,e')),q) = I_{(\mathcal{A}\times\mathcal{B})}((yx,e'e'),q))$

$= \max\{I_{\mathcal{A}}(yx,q), \mu_{\mathcal{B}}((e'e'),q)\} = I_{\mathcal{A}}(yx,q)$

Similarly, $f_{\mathcal{A}}(xy,q) = f_{\mathcal{A}}(yx,q)$.Hence $\mathcal{A}$ is a NQFNSR of R_1. $\mathcal{B}$ Follow the same way we can find is a NQFNSR of R_2.

Theorem.4.3 Let$\mathcal{A}$ and $\mathcal{B}$ be NQFNSR of R_1 and R_2 respectively then $\mathcal{A}\times\mathcal{B}$ be a NQFNSRof $R_1 \times R_2$.

Proof: Let$\mathcal{A}$and $\mathcal{B}$ be NQFNSRof R_1 and R_2. In theorem 3.11 we proved that $\mathcal{A}\times\mathcal{B}$ is a NQFSR of $R_1 \times R_2$. It is enough to show the normality.

$\mu_{(\mathcal{A}\times\mathcal{B})}[(x_1,y_1)(x_2,y_2),q] = \mu_{(\mathcal{A}\times\mathcal{B})}((x_1x_2),(y_1y_2),q) = \min\{\mu_{\mathcal{A}}((x_2x_1),q), \mu_{\mathcal{B}}(y_2y_1),q)\}$

$= \mu_{(\mathcal{A}\times\mathcal{B})}((x_2x_1),(y_2y_1),q) = \mu_{(\mathcal{A}\times\mathcal{B})}((x_2,y_2),(x_1,y_1),q)$

$I_{(\mathcal{A}\times\mathcal{B})}[(x_1,y_1)(x_2,y_2),q] = I_{(\mathcal{A}\times\mathcal{B})}((x_1x_2),(y_1y_2),q) = \max\{I_{\mathcal{A}}((x_2x_1),q), I_{\mathcal{B}}(y_2y_1),q)\}$

$= I_{(\mathcal{A}\times\mathcal{B})}((x_2x_1),(y_2y_1),q) = I_{(\mathcal{A}\times\mathcal{B})}((x_2,y_2),(x_1,y_1),q)$

Similarly, $f_{(\mathcal{A}\times\mathcal{B})}[(x_1,y_1)(x_2,y_2),q] = f_{(\mathcal{A}\times\mathcal{B})}((x_2,y_2)(x_1,y_1),q),(x_1,y_1)(x_2,y_2) \in R_1 \times R_2\ q \in Q$.Hence $\mathcal{A}\times\mathcal{B}$ is a NQFSR of $R_1 \times R_2$.

Hence $\mathcal{A}\times\mathcal{B}$ is a NQFNSR of $R_1 \times R_2$.

Theorem.4.4 If$\mathcal{A} = \mathcal{A}_1 \times \mathcal{A}_2$and $\mathcal{B} = \mathcal{B}_1 \times \mathcal{B}_2$ are two NQFNSRof$R_1 \times R_2$ then their intersection $\mathcal{A}\cap\mathcal{B}$ is also a NQFNSR of $R_1 \times R_2$.

Proof: Let $\mathcal{A} = \mathcal{A}_1 \times \mathcal{A}_2$and $\mathcal{B} = \mathcal{B}_1 \times \mathcal{B}_2$ be two NQFNSRof $R_1 \times R_2$.

Let $\mathcal{C}=\mathcal{A}\cap\mathcal{B}$. Let$(z_1,z_2),(z_3,z_4) \in \mathcal{C}$. Now,$\mu_{\mathcal{C}}[(z_1,z_2)-(z_3,z_4),q] = \mu_{\mathcal{A}\cap\mathcal{B}}[(z_1,z_2)-(z_3,z_4),q] = \min$

$\{\mu_{\mathcal{A}}((z_1,z_2)-(z_3,z_4),q), \mu_{\mathcal{B}}(z_1,z_2)-(z_3,z_4),q)\} \geq \min\begin{Bmatrix}\min\{\mu_{\mathcal{A}}((z_1,z_2),q),\mu_{\mathcal{A}}((z_3,z_4),q)\}\\ \min\left\{\left(\mu_{\mathcal{B}}((z_1,z_2),q)\right), \mu_{\mathcal{B}}((z_3,z_4),q)\right\}\end{Bmatrix} \geq \min$

$\begin{Bmatrix}\min\{\mu_{\mathcal{A}}((z_1,z_2),q), \mu_{\mathcal{B}}((z_1,z_2),q)\}\\ \min\left\{\left(\mu_{\mathcal{A}}((z_3,z_4),q)\right), \mu_{\mathcal{B}}((z_3,z_4),q)\right\}\end{Bmatrix} \geq \min\{\mu_{\mathcal{A}\cap\mathcal{B}}((z_1,z_2),q),\mu_{\mathcal{A}\cap\mathcal{B}}((z_3,z_4),q)\}.$

$,I_{\mathcal{C}}[(z_1,z_2)-(z_3,z_4),q] = I_{\mathcal{A}\cap\mathcal{B}}[(z_1,z_2)-(z_3,z_4),q] \leq \max\begin{Bmatrix}\max\{\mu_{\mathcal{A}}((z_1,z_2),q),\mu_{\mathcal{A}}((z_3,z_4),q)\}\\ \max\left\{\left(\mu_{\mathcal{B}}((z_1,z_2),q)\right), \mu_{\mathcal{B}}((z_3,z_4),q)\right\}\end{Bmatrix} \leq$

$\max\begin{Bmatrix}\max\{\mu_{\mathcal{A}}((z_1,z_2),q), \mu_{\mathcal{B}}((z_1,z_2),q)\}\\ \max\left\{\left(\mu_{\mathcal{A}}((z_3,z_4),q)\right), \mu_{\mathcal{B}}((z_3,z_4),q)\right\}\end{Bmatrix} \leq \max\{I_{\mathcal{A}\cap\mathcal{B}}((z_1,z_2),q), I_{\mathcal{A}\cap\mathcal{B}}((z_3,z_4),q)\}.$

Similarly, $f_{(\mathcal{A}\times\mathcal{B})}[(z_1,z_3)-(z_2,z_4),q] \leq \max\{f_{(\mathcal{A}\times\mathcal{B})}((z_1,z_3),q), f_{(\mathcal{A}\times\mathcal{B})}((z_2,z_4),q)\}$

Also, $\mu_{\mathcal{C}}[(z_1,z_2).(z_3,z_4),q] = \mu_{\mathcal{A}\cap\mathcal{B}}((z_1z_2),(z_3z_4),q) = \min\{\mu_{\mathcal{A}}((z_1z_2)(z_3z_4),q), \mu_{\mathcal{B}}(z_1z_2)(z_3z_4),q)\} \geq$

$\min\begin{Bmatrix}\min\{\mu_{\mathcal{A}}((z_1z_2),q),\mu_{\mathcal{A}}((z_3z_4),q)\}\\ \min\{\mu_{\mathcal{B}}((z_1z_2),q), \mu_{\mathcal{B}}((z_3z_4),q)\}\end{Bmatrix} \geq$

$\min\begin{Bmatrix}\min\{\mu_{\mathcal{A}}((z_1z_2),q),\left(\mu_{\mathcal{B}}((z_1z_2),q)\right)\}\\ \min\{\mu_{\mathcal{A}}((z_3z_4),q), \mu_{\mathcal{B}}((z_3z_4),q)\}\end{Bmatrix} \geq \min\{\mu_{\mathcal{A}\cap\mathcal{B}}((z_1,z_2),q),\mu_{\mathcal{A}\cap\mathcal{B}}((z_3,z_4),q)\} = \min\{\mu_{\mathcal{C}}((z_1,z_2),q),\mu_{\mathcal{C}}((z_3,z_4),q)\}.$

$I_{\mathcal{C}}[(z_1,z_2).(z_3,z_4),q] = I_{\mathcal{A}\cap\mathcal{B}}((z_1z_2),(z_3z_4),q) = \max\{I_{\mathcal{A}}((z_1z_2)(z_3z_4),q), I_{\mathcal{B}}(z_1z_2)(z_3z_4),q)\} \geq$

$\max\begin{Bmatrix}\max\{I_{\mathcal{A}}((z_1z_2),q),I_{\mathcal{A}}((z_3z_4),q)\}\\ \max\{I_{\mathcal{B}}((z_1z_2),q),I_{\mathcal{B}}((z_3z_4),q)\}\end{Bmatrix} \leq \max\begin{Bmatrix}\max\{I_{\mathcal{A}}((z_1z_2),q),\left(I_{\mathcal{B}}((z_1z_2),q)\right)\}\\ \max\{I_{\mathcal{A}}((z_3z_4),q),I_{\mathcal{B}}((z_3z_4),q)\}\end{Bmatrix} \leq$

$\max\{I_{\mathcal{A}\cap\mathcal{B}}((z_1,z_2),q),I_{\mathcal{A}\cap\mathcal{B}}((z_3,z_4),q)\} = \max\{I_{\mathcal{C}}((z_1,z_2),q),I_{\mathcal{C}}((z_3,z_4),q)\}.$

Similarly, $f_{\mathcal{C}}[(z_1,z_2).(z_3,z_4),q] \leq \max\{f_{\mathcal{C}}((z_1,z_2),q),f_{\mathcal{C}}((z_3,z_4),q)\}.$

$\mathcal{C} = (\mu_{\mathcal{C}}, I_{\mathcal{C}}, f_{\mathcal{C}})$ is a $\mathcal{N}$-QF$\mathcal{S}$□ of $R_1 \times R_2$

Now we are moving to show the normality condition,

$\mu_{C}[((\mathfrak{z}_1\mathfrak{z}_2)(\mathfrak{z}_3\mathfrak{z}_4),q)] = \mu_{A\cap B}((\mathfrak{z}_1\mathfrak{z}_2)(\mathfrak{z}_3\mathfrak{z}_4),q) = \min\{\mu_A((\mathfrak{z}_1\mathfrak{z}_2)(\mathfrak{z}_3\mathfrak{z}_4),q),\ \mu_B((\mathfrak{z}_1\mathfrak{z}_2)(\mathfrak{z}_3\mathfrak{z}_4),q)\} =$
$\min\{\mu_A((\mathfrak{z}_3\mathfrak{z}_4)(\mathfrak{z}_1\mathfrak{z}_2),q),\ \mu_B((\mathfrak{z}_3\mathfrak{z}_4)(\mathfrak{z}_1\mathfrak{z}_2),q)\} = \mu_{A\cap B}((\mathfrak{z}_3\mathfrak{z}_4)(\mathfrak{z}_1\mathfrak{z}_2),q) = \mu_{C}[((\mathfrak{z}_3\mathfrak{z}_4)(\mathfrak{z}_1\mathfrak{z}_2),q)]$

$И_{C}[((\mathfrak{z}_1\mathfrak{z}_2)(\mathfrak{z}_3\mathfrak{z}_4),q)] = И_{A\cap B}((\mathfrak{z}_1\mathfrak{z}_2)(\mathfrak{z}_3\mathfrak{z}_4),q) = \max\{И_A((\mathfrak{z}_1\mathfrak{z}_2)(\mathfrak{z}_3\mathfrak{z}_4),q), И_B((\mathfrak{z}_1\mathfrak{z}_2)(\mathfrak{z}_3\mathfrak{z}_4),q)\} =$
$\max\{И_A((\mathfrak{z}_3\mathfrak{z}_4)(\mathfrak{z}_1\mathfrak{z}_2),q), И_B((\mathfrak{z}_3\mathfrak{z}_4)(\mathfrak{z}_1\mathfrak{z}_2),q)\} = И_{A\cap B}((\mathfrak{z}_3\mathfrak{z}_4)(\mathfrak{z}_1\mathfrak{z}_2),q) = И_{C}[((\mathfrak{z}_3\mathfrak{z}_4)(\mathfrak{z}_1\mathfrak{z}_2),q)]$

similarly, $f_{C}[((\mathfrak{z}_1\mathfrak{z}_2)(\mathfrak{z}_3\mathfrak{z}_4),q)] = f_{C}[((\mathfrak{z}_3\mathfrak{z}_4)(\mathfrak{z}_1\mathfrak{z}_2),q)]$.

Hence $C = (\mu_C, И_C, f_C) = (\mu_{A\cap B}, И_{A\cap B}, f_{A\cap B})$ is a NQFNSRof $R_1 \times R_2$.

Theorem.4.5 If $A = A_1 \times A_2$ and $B = B_1 \times B_2$ are two NQFNSRof $R' = R_1 \times R_2$ and $R'' = R_3 \times R_4$ respectively then $C = A \times B$ is also a NQFNSR of $R' \times R'' = ((R_1 \times R_2) \times (R_3 \times R_4))$.

Proof: Let $A = A_1 \times A_2$ and $B = B_1 \times B_2$ be two N-QFNS□ of $R' = R_1 \times R_2$ and $R'' = R_3 \times R_4$ respectively. Now,

$\mu_{C}[((\mathfrak{z}_1,\mathfrak{z}_2)(\mathfrak{z}_3,\mathfrak{z}_4) - (\mathfrak{z}_5,\mathfrak{z}_6)(\mathfrak{z}_7,\mathfrak{z}_8),q)] = \mu_{A\times B}[((\mathfrak{z}_1,\mathfrak{z}_2)(\mathfrak{z}_3,\mathfrak{z}_4) - (\mathfrak{z}_5,\mathfrak{z}_6)(\mathfrak{z}_7,\mathfrak{z}_8),q)]$

$= \mu_{A\times B}\left(((\mathfrak{z}_1,\mathfrak{z}_2) - (\mathfrak{z}_5,\mathfrak{z}_6),q)((\mathfrak{z}_3,\mathfrak{z}_4) - (\mathfrak{z}_7,\mathfrak{z}_8),q)\right) = \min\left\{\mu_A\left(((\mathfrak{z}_1,\mathfrak{z}_2) - (\mathfrak{z}_5,\mathfrak{z}_6),q)\right),\ \mu_B\left(((\mathfrak{z}_3,\mathfrak{z}_4) - (\mathfrak{z}_7,\mathfrak{z}_8),q)\right)\right\} \geq$

$$\min\begin{Bmatrix}\min\{\mu_A((\mathfrak{z}_1,\mathfrak{z}_2),q),\mu_A((\mathfrak{z}_5,\mathfrak{z}_6),q)\}\\ \min\left\{\left(\mu_B((\mathfrak{z}_3,\mathfrak{z}_4),q)\right),\ \mu_B((\mathfrak{z}_7,\mathfrak{z}_8),q)\right\}\end{Bmatrix} \geq$$

$$\min\begin{Bmatrix}\min\{\mu_A((\mathfrak{z}_1,\mathfrak{z}_2),q),\left(\mu_B((\mathfrak{z}_3,\mathfrak{z}_4),q)\right)\}\\ \min\{\mu_A((\mathfrak{z}_5,\mathfrak{z}_6),q),\ \mu_B((\mathfrak{z}_7,\mathfrak{z}_8),q)\}\end{Bmatrix} \geq$$

$\min\{\mu_{A\times B}((\mathfrak{z}_1,\mathfrak{z}_2)(\mathfrak{z}_3,\mathfrak{z}_4),q),\mu_{A\times B}((\mathfrak{z}_5,\mathfrak{z}_6)(\mathfrak{z}_7,\mathfrak{z}_8),q)\} = \min\{\mu_C((\mathfrak{z}_1,\mathfrak{z}_2)(\mathfrak{z}_3,\mathfrak{z}_4),q),\mu_C((\mathfrak{z}_5,\mathfrak{z}_6)(\mathfrak{z}_7,\mathfrak{z}_8),q)\}$

$И_{C}[((\mathfrak{z}_1,\mathfrak{z}_2)(\mathfrak{z}_3,\mathfrak{z}_4) - (\mathfrak{z}_5,\mathfrak{z}_6)(\mathfrak{z}_7,\mathfrak{z}_8),q)] = И_{A\times B}[((\mathfrak{z}_1,\mathfrak{z}_2)(\mathfrak{z}_3,\mathfrak{z}_4) - (\mathfrak{z}_5,\mathfrak{z}_6)(\mathfrak{z}_7,\mathfrak{z}_8),q)]$

$= И_{A\times B}\left(((\mathfrak{z}_1,\mathfrak{z}_2) - (\mathfrak{z}_5,\mathfrak{z}_6),q)((\mathfrak{z}_3,\mathfrak{z}_4) - (\mathfrak{z}_7,\mathfrak{z}_8),q)\right) = \min\left\{И_A\left(((\mathfrak{z}_1,\mathfrak{z}_2) - (\mathfrak{z}_5,\mathfrak{z}_6),q)\right), И_B\left(((\mathfrak{z}_3,\mathfrak{z}_4) - (\mathfrak{z}_7,\mathfrak{z}_8),q)\right)\right\} \leq$

$$\max\begin{Bmatrix}\max\{И_A((\mathfrak{z}_1,\mathfrak{z}_2),q),И_A((\mathfrak{z}_5,\mathfrak{z}_6),q)\}\\ \max\left\{\left(И_B((\mathfrak{z}_3,\mathfrak{z}_4),q)\right),И_B((\mathfrak{z}_7,\mathfrak{z}_8),q)\right\}\end{Bmatrix} \leq$$

$$\max\begin{Bmatrix}\max\{И_A((\mathfrak{z}_1,\mathfrak{z}_2),q),\left(И_B((\mathfrak{z}_3,\mathfrak{z}_4),q)\right)\}\\ \max\{И_A((\mathfrak{z}_5,\mathfrak{z}_6),q),И_B((\mathfrak{z}_7,\mathfrak{z}_8),q)\}\end{Bmatrix} \leq$$

$\max\{И_{A\times B}((\mathfrak{z}_1,\mathfrak{z}_2)(\mathfrak{z}_3,\mathfrak{z}_4),q),И_{A\times B}((\mathfrak{z}_5,\mathfrak{z}_6)(\mathfrak{z}_7,\mathfrak{z}_8),q)\} = \max\{И_C((\mathfrak{z}_1,\mathfrak{z}_2)(\mathfrak{z}_3,\mathfrak{z}_4),q),И_C((\mathfrak{z}_5,\mathfrak{z}_6)(\mathfrak{z}_7,\mathfrak{z}_8),q)\}$

Similarly, $f_{C}[((\mathfrak{z}_1,\mathfrak{z}_2)(\mathfrak{z}_3,\mathfrak{z}_4) - (\mathfrak{z}_5,\mathfrak{z}_6)(\mathfrak{z}_7,\mathfrak{z}_8),q)] \leq \max\{f_C((\mathfrak{z}_1,\mathfrak{z}_2)(\mathfrak{z}_3,\mathfrak{z}_4),q),f_C((\mathfrak{z}_5,\mathfrak{z}_6)(\mathfrak{z}_7,\mathfrak{z}_8),q)\}$.

$\mu_{C}[((\mathfrak{z}_1,\mathfrak{z}_2)(\mathfrak{z}_3,\mathfrak{z}_4).(\mathfrak{z}_5,\mathfrak{z}_6)(\mathfrak{z}_7,\mathfrak{z}_8),q)] = \mu_{A\times B}[((\mathfrak{z}_1,\mathfrak{z}_2)(\mathfrak{z}_3,\mathfrak{z}_4).(\mathfrak{z}_5,\mathfrak{z}_6)(\mathfrak{z}_7,\mathfrak{z}_8),q)] =$

$\mu_{A\times B}\left(((\mathfrak{z}_1,\mathfrak{z}_2).(\mathfrak{z}_5,\mathfrak{z}_6),q)((\mathfrak{z}_3,\mathfrak{z}_4).(\mathfrak{z}_7,\mathfrak{z}_8),q)\right) = \min\left\{\mu_A\left(((\mathfrak{z}_1,\mathfrak{z}_2).(\mathfrak{z}_5,\mathfrak{z}_6),q)\right),\ \mu_B\left(((\mathfrak{z}_3,\mathfrak{z}_4).(\mathfrak{z}_7,\mathfrak{z}_8),q)\right)\right\} \geq$

$$\min\begin{Bmatrix}\min\{\mu_A((\mathfrak{z}_1,\mathfrak{z}_2),q),\mu_A((\mathfrak{z}_5,\mathfrak{z}_6),q)\}\\ \min\left\{\left(\mu_B((\mathfrak{z}_3,\mathfrak{z}_4),q)\right),\ \mu_B((\mathfrak{z}_7,\mathfrak{z}_8),q)\right\}\end{Bmatrix} \geq$$

$$\min\begin{Bmatrix}\min\{\mu_\emptyset((\mathfrak{z}_1,\mathfrak{z}_2),q),\left(\mu_B((\mathfrak{z}_3,\mathfrak{z}_4),q)\right)\}\\ \min\{\mu_\emptyset((\mathfrak{z}_5,\mathfrak{z}_6),q),\ \mu_B((\mathfrak{z}_7,\mathfrak{z}_8),q)\}\end{Bmatrix} \geq$$

$\min\{\mu_{A\times B}((\mathfrak{z}_1,\mathfrak{z}_2)(\mathfrak{z}_3,\mathfrak{z}_4),q),\mu_{A\times B}((\mathfrak{z}_5,\mathfrak{z}_6)(\mathfrak{z}_7,\mathfrak{z}_8),q)\} = \min\{\mu_C((\mathfrak{z}_1,\mathfrak{z}_2)(\mathfrak{z}_3,\mathfrak{z}_4),q),\mu_C((\mathfrak{z}_5,\mathfrak{z}_6)(\mathfrak{z}_7,\mathfrak{z}_8),q)\}$

$И_{C}[((\mathfrak{z}_1,\mathfrak{z}_2)(\mathfrak{z}_3,\mathfrak{z}_4).(\mathfrak{z}_5,\mathfrak{z}_6)(\mathfrak{z}_7,\mathfrak{z}_8),q)] = И_{A\times B}[((\mathfrak{z}_1,\mathfrak{z}_2)(\mathfrak{z}_3,\mathfrak{z}_4).(\mathfrak{z}_5,\mathfrak{z}_6)(\mathfrak{z}_7,\mathfrak{z}_8),q)] =$

$И_{A\times B}\left(((\mathfrak{z}_1,\mathfrak{z}_2).(\mathfrak{z}_5,\mathfrak{z}_6),q)((\mathfrak{z}_3,\mathfrak{z}_4).(\mathfrak{z}_7,\mathfrak{z}_8),q)\right) = \min\left\{И_A\left(((\mathfrak{z}_1,\mathfrak{z}_2).(\mathfrak{z}_5,\mathfrak{z}_6),q)\right), И_B\left(((\mathfrak{z}_3,\mathfrak{z}_4).(\mathfrak{z}_7,\mathfrak{z}_8),q)\right)\right\} \leq$

$$\max\begin{Bmatrix}\max\{И_A((\mathfrak{z}_1,\mathfrak{z}_2),q),И_A((\mathfrak{z}_5,\mathfrak{z}_6),q)\}\\ \max\left\{\left(И_B((\mathfrak{z}_3,\mathfrak{z}_4),q)\right),И_B((\mathfrak{z}_7,\mathfrak{z}_8),q)\right\}\end{Bmatrix} \leq$$

$$\max\begin{Bmatrix}\max\{И_A((\mathfrak{z}_1,\mathfrak{z}_2),q),\left(И_B((\mathfrak{z}_3,\mathfrak{z}_4),q)\right)\}\\ \max\{И_A((\mathfrak{z}_5,\mathfrak{z}_6),q),И_B((\mathfrak{z}_7,\mathfrak{z}_8),q)\}\end{Bmatrix} \geq$$

$\max\{И_{A\times B}((\mathfrak{z}_1,\mathfrak{z}_2)(\mathfrak{z}_3,\mathfrak{z}_4),q),И_{A\times B}((\mathfrak{z}_5,\mathfrak{z}_6)(\mathfrak{z}_7,\mathfrak{z}_8),q)\} = \max\{И_C((\mathfrak{z}_1,\mathfrak{z}_2)(\mathfrak{z}_3,\mathfrak{z}_4),q),И_C((\mathfrak{z}_5,\mathfrak{z}_6)(\mathfrak{z}_7,\mathfrak{z}_8),q)\}$

Similarly, $f_{C}[((\mathfrak{z}_1,\mathfrak{z}_2)(\mathfrak{z}_3,\mathfrak{z}_4).(\mathfrak{z}_5,\mathfrak{z}_6)(\mathfrak{z}_7,\mathfrak{z}_8),q)] \leq \max\{f_C((\mathfrak{z}_1,\mathfrak{z}_2)(\mathfrak{z}_3,\mathfrak{z}_4),q),f_C((\mathfrak{z}_5,\mathfrak{z}_6)(\mathfrak{z}_7,\mathfrak{z}_8),q)\}$

$C = A \times B$ is also NQFSR of $R' \times R'' = ((R_1 \times R_2) \times (R_3 \times R_4))$.

Now,

$\mu_{C}[((\mathfrak{Z}_1,\mathfrak{Z}_2)(\mathfrak{Z}_3,\mathfrak{Z}_4).(\mathfrak{Z}_5,\mathfrak{Z}_6)(\mathfrak{Z}_7,\mathfrak{Z}_8),q)]=\mu_{A\times B}[((\mathfrak{Z}_1,\mathfrak{Z}_2)(\mathfrak{Z}_3,\mathfrak{Z}_4).(\mathfrak{Z}_5,\mathfrak{Z}_6)(\mathfrak{Z}_7,\mathfrak{Z}_8),q)]$

$=\min\{\mu_A((\mathfrak{Z}_1,\mathfrak{Z}_2).(\mathfrak{Z}_5,\mathfrak{Z}_6),q)),\ \mu_B((\mathfrak{Z}_3,\mathfrak{Z}_4).(\mathfrak{Z}_7,\mathfrak{Z}_8),q))\}$

$=\min\{\mu_A((\mathfrak{Z}_5,\mathfrak{Z}_6).(\mathfrak{Z}_1,\mathfrak{Z}_2),q)),\ \mu_B((\mathfrak{Z}_7,\mathfrak{Z}_8).(\mathfrak{Z}_3,\mathfrak{Z}_4),q))\}=\mu_{A\times B}[((\mathfrak{Z}_5,\mathfrak{Z}_6).(\mathfrak{Z}_1,\mathfrak{Z}_2),(\mathfrak{Z}_7,\mathfrak{Z}_8).(\mathfrak{Z}_3,\mathfrak{Z}_4),q))]$

$=\mu_{A\times B}[((\mathfrak{Z}_5,\mathfrak{Z}_6),(\mathfrak{Z}_7,\mathfrak{Z}_8).(\mathfrak{Z}_1,\mathfrak{Z}_2).(\mathfrak{Z}_3,\mathfrak{Z}_4),q))]=\mu_{C}[((\mathfrak{Z}_5,\mathfrak{Z}_6),(\mathfrak{Z}_7,\mathfrak{Z}_8).(\mathfrak{Z}_1,\mathfrak{Z}_2).(\mathfrak{Z}_3,\mathfrak{Z}_4),q))]$

$I_{C}[((\mathfrak{Z}_1,\mathfrak{Z}_2)(\mathfrak{Z}_3,\mathfrak{Z}_4).(\mathfrak{Z}_5,\mathfrak{Z}_6)(\mathfrak{Z}_7,\mathfrak{Z}_8),q)]=I_{A\times B}[((\mathfrak{Z}_1,\mathfrak{Z}_2)(\mathfrak{Z}_3,\mathfrak{Z}_4).(\mathfrak{Z}_5,\mathfrak{Z}_6)(\mathfrak{Z}_7,\mathfrak{Z}_8),q)]$

$=\max\{I_A((\mathfrak{Z}_1,\mathfrak{Z}_2).(\mathfrak{Z}_5,\mathfrak{Z}_6),q)),I_B((\mathfrak{Z}_3,\mathfrak{Z}_4).(\mathfrak{Z}_7,\mathfrak{Z}_8),q))\}$

$=\max\{I_A((\mathfrak{Z}_5,\mathfrak{Z}_6).(\mathfrak{Z}_1,\mathfrak{Z}_2),q)),I_B((\mathfrak{Z}_7,\mathfrak{Z}_8).(\mathfrak{Z}_3,\mathfrak{Z}_4),q))\}=I_{A\times B}[((\mathfrak{Z}_5,\mathfrak{Z}_6).(\mathfrak{Z}_1,\mathfrak{Z}_2),(\mathfrak{Z}_7,\mathfrak{Z}_8).(\mathfrak{Z}_3,\mathfrak{Z}_4),q))]$

$=I_{A\times B}[((\mathfrak{Z}_5,\mathfrak{Z}_6),(\mathfrak{Z}_7,\mathfrak{Z}_8).(\mathfrak{Z}_1,\mathfrak{Z}_2).(\mathfrak{Z}_3,\mathfrak{Z}_4),q))]=I_{C}[((\mathfrak{Z}_5,\mathfrak{Z}_6),(\mathfrak{Z}_7,\mathfrak{Z}_8).(\mathfrak{Z}_1,\mathfrak{Z}_2).(\mathfrak{Z}_3,\mathfrak{Z}_4),q))]$

$f_{C}[((\mathfrak{Z}_1,\mathfrak{Z}_2)(\mathfrak{Z}_3,\mathfrak{Z}_4).(\mathfrak{Z}_5,\mathfrak{Z}_6)(\mathfrak{Z}_7,\mathfrak{Z}_8),q)]=f_{C}[((\mathfrak{Z}_5,\mathfrak{Z}_6),(\mathfrak{Z}_7,\mathfrak{Z}_8).(\mathfrak{Z}_1,\mathfrak{Z}_2).(\mathfrak{Z}_3,\mathfrak{Z}_4),q))]$

Hence $C=A\times B$ is also a NQFNSRof $R'\times R''=((R_1\times R_2)\times(R_3\times R_4))$.

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RESEARCH ARTICLE

Evaluation of Successive Fractions of *Bergenia ciliate* Sternb (Root) Crude Extract for Phytochemical Analysis, Antioxidant and Antibacterial Activities against MDR-Carbapenem Resistant Organisms Causing Respiratory Infections

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ABSTRACT

The antibiotic resistance of bacterial pathogens is a worldwide growing concern. The resistance occurs when there is abrupt use of antimicrobial drugs. Bacteria are becoming more tolerant of the medication we are providing to treat them. Some of them are resistant to more than one drug and this phenomenon is referred to Multi-Drug Resistance (MDR). Carbapenem is an effective drug that has been used for a very long time. It's the last resort so far, but due to the presence of carbapenemase enzymes in certain bacteria they are resisting the inhibitory effect of this drug which makes them difficult to treat, hence there is an urgent need to find an effective alternative for it. Microbes in reference are Carbapenem-resistant organisms (CRO). The present study mainly focuses on examining the therapeutic profile of *Bergenia ciliata* root extract in terms of antimicrobial and antioxidant activity. The extract preparation was done using different solvents of increasing polarity. Agar well diffusion method is used for determining antimicrobial activity in which the Methanolic extract has shown the maximum antibacterial activity against all the test organisms with the maximum zone of inhibition (25mm) and least inhibitory zone was observed in ethyl acetate extract (13mm) compared to the control in reference (maximum ZOI-32mm, minimum ZOI-22mm). DPPH Assay is used for examining the antioxidant activity of the root extract in which the principal compound was DPPH. For the DPPH assay, ethyl acetate has the highest inhibition % (78.64%±0.003) followed by methanol (76.92%±0.002) then aqueous extracts (76.61%±0.002).

Phytochemical analysis was done using GCMS and HPLC techniques to evaluate the presence of secondary metabolites that are responsible for its therapeutic activity. The present research builds a foundation in finding an effective alternative for the carbapenem-resistant drugs which are prepared from *Bergenia ciliata* roots. These herbaceous medicated formulae have no or fewer side effects, being value effective and it is also under the reach of the unprivileged society.

Keywords: *Bergenia ciliata* , DPPH, carbapenems, carbapenem-resistant organisms (CRO), GNB (gram-negative bacteria), GPC (gram-positive bacteria).

INTRODUCTION

Infections have become the second most common reason for death worldwide [1]. The antimicrobial agent Carbapenems are one of the most effective drugs used to treat nosocomial infections. It has a wide range of antimicrobial activity against many GNB-GPC bacteria and because of its vulnerability to beta-lactam resistance determinants, it has become the most reliable last resort for treating them[2]. Furthermore, it has shown fewer side effects than other last-line drugs. Therefore, the continuously increasing resistance to carbapenem drugs, especially among gram-negative bacteria, has emerged in global public healthcare [3]**.** The gram-negative resistant bacteria (MDR-GNB), such as *Pseudomonas aeruginosa, Klebsiella pneumonia, Acinetobacter baumannii,*or other associates of Entero bacterales are responsible for causing an increased incidence of infections that have somewhere affected the appropriate treatment and ultimately lead to an increase in mortality and morbidity in patients [4,5]. **The environment is associated integral a part of human life. it's been ascertained those plants and their elements are used as a healthful compound for many decades.** They are being utilized by the ancient healthcare system and are of boundless importance. In recent times, herbal medicine gained immense popularity among modern researchers and they are in the current medical system. Their antioxidant and antimicrobial activities are used to treat many pathogenic conditions which are hazardous to human life [6,7]**.** These pharmacologic activities of such plants may be due to the presence of numerous biochemicals in them. Extracts of different parts of plants such as rootstock, leaf, etc are traditionally used in the form of powder, essence, drink, or herbs to treat the different ailments [8,9]. *Bergenia ciliata* is one of those medicinal plants that has attracted several researchers due to its variety of medicinal activities.

The plant and its part have been used to treat many infections such as lung infections, stomach infections, skin diseases, muscular/skeletal disorders, fever, eye diseases, parasitic infection, diarrhoea, kidney disorders, high fever, mouth infections, tumours, and gynaecological disorders in traditional medicine [10]**.** The rhizome and roots of *Bergenia ciliata* have plenty of secondary metabolites present in it like glycoside, alkaloid, terpenoid, steroid, flavonoid, reducing sugar, tannin, fatty acid, saponin, bergenin, catechin, phenolic compounds, arbutin, allicin, gallic acid, tannic acid, glucose, albumens, mucilage, wax, albumen, mineral salts, sterols [11,12]. In Ayurveda, rhizome and roots of *Bergenia ciliata* have been used as a stimulant, constringent, antiscorbutic, and constipation reliever to treat infections like leucorrhoea, for dissolving gall-bladder and renal stones and pulmonary infections [13,14]**.** The crude plant extract of *Bergenia* has shown effective antimicrobial activities against *Candida albicans, Bacillus cereus, Escherichia coli, Staphylococcus aureus, and Pseudomonas aeruginosa [15]***.** This research has enlightened the disease curing abilities and free radical neutralizing properties of *Bergenia ciliata* root against selected MDR-CRO pathogens responsible for causing respiratory afflictions with some significant results. The outcome of this research will also help other researchers in further examining and analyzing the bioactivity of the plant. The species of *Bergenia ciliata* was collected from the local area of Joshimath, Uttarakhand, India.

MATERIALS

Plant collection

Fresh plant samples were collected from different regions of Uttarakhand, India which mainly includes some areas of Joshimath (Longitude: 79.565964, Latitude: 30.550552). The plant species was authenticated by the Botanical Survey of India, Dehradun with the accession number from "375".

Microorganisms

The microorganisms that were used for the study are Gram-negative MDR-CRO *Pseudomonas aeruginosa, Acinetobacter baumannii, and Klebsiella pneumonia.* All the microbial cultures were procured from IMTECH Chandigarh and preserved on agar slants at 4℃.

Reagents and Chemicals

All chemicals and reagents which were used such as DPPH (1,1-diphenyl-2-picrylhydrazyl), sulfoxide (DMSO), Nutrient agar and Nutrient broth, Muller Hinton Agar and Broth, Methanol, Ethyl acetate, Hydrochloric acid, Ethanol, Gallic acid, Tris's buffer are of prime quality and purchased from Hi-Media, Mumbai, India. Distilled water was used for experimental purpose.

METHODS

Preparation of plant extracts

In this study, three different solvents were used for extraction according to their increasing polarity i.e., ethyl acetate (4.4) methanol (5.1), and aqueous (9.0). The root was first washed with clean water and then shade dried for 9-10 days. After that, using a motor pestle fine powder was formed. For extraction of 25 gm of *B. ciliata* , root powder was added to 250ml of solvents and then subjected to Soxhlet apparatus. The process and ratio were maintained the same for all three solvent extractions. The boiling temperature was 100°C for aqueous, 77.1°C for Ethyl acetate, and 64.7°C for Methanol. To get the extracts in concentrated form, it was evaporated at a temperature between 70-10°C. The yield was calculated by weighing all the extracts and then stored in an airtight tube **[16].**

Antimicrobial Activity

To determine the antibacterial activity of all the extracts (ethyl acetate, methanol, and aqueous) of *Bergenia ciliata* root, the agar well diffusion methodology was used[17]. To get the concentration of 0.5mg in 100µl and 1mg in 100µl, the extracts were dissolved in DMSO (dimethylsulphoxide). For positive control, Cefoperazone + Sulbactam was used **(**0.5mg in 100µl and 1mg in 100µl) and for the negative control, DMSO was used. In this method, Muller - Hinton agar plates were inoculated with 20 µl of bacterial suspension and spread evenly all over the medium. The 9mm well-cut was made into the agar plates. The well was filled with a definite number of extracts (0.5mg in 100µl and 1mg in 100µl) and then the plates were placed for incubation at 37ºC for 18h – 24h. The antibacterial activity of the subjected extracts was noted by measuring the zone of inhibition obtained [18].

Minimum Inhibitory Concentration Assay and Minimum Bactericidal Concentration Assay [17]

Broth dilution method was used to determine the MIC of all the extracts (methanolic root extract, ethyl acetate root extract, and aqueous root [17]**.** Firstly, a two-fold serial dilution of the extract was prepared using Mueller- Hinton Broth (Hi-media, Mumbai) in well plates, and then 20µL of the test organism (CRO pathogens) at the standard concentration of 5 X 105Cfu/ml was added to it and the well plates were placed for the incubation for 24hrs at 37°C. The process was repeated for all the extracts, with positive **(Cefoperazone + Sulbactam)** and negative (DMSO) control respectively. The lowest concentration at which the extract and standard antibiotics exhibited no noticeable growth (turbidity) is considered MBC. After determining MIC, the minimum bactericidal concentration (MBC) of extracts was evaluated by the sub-culturing method. The Inoculum was taken from each of the microplates well of broth on Mueller-Hinton agar plates and kept in an incubator for 18- 24hrs at 37°C. Now each colony on the MHA plate was counted and compared to the number of colonies forming units/ml in the original inoculums. The lowest

concentration of root extracts that had the most bactericidal effect (i.e., 99% killing of bacterial isolates) was measured as an MBC **[19]. The MIC index was also calculated to evaluate the bactericidal and bacteriostatic activity in which MIC index values >4 is bacteriostatic while <4 is bactericidal for the extracts [17].**

DPPH Assay

The antioxidant scavenging activity of *Bergenia ciliata* root extracts was confirmed by the DPPH methodology **[20].** In this method stable 1, 1-diphenyl-2-picrylhydrazyl (DPPH) was used. The solution was freshly formed by dissolving 1-diphenyl-2-picrylhydrazyl (DPPH) 1ml in 700µl of ethanol and 800µl of Tris (.1molar) with continuous stirring and kept at a dark room temperature for 2hours. Now, this mixture is added to a specific volume of plant extracts taken in different quantities (25µl, 50µl, 75µl, 100µl, 125µl, 150µl, 175µl, 200µl, 225µl, 250µl) and then mixed and kept for incubation for 30 minutes at 37°C. After incubating the solution, the absorbance was read at 517 nm using a Spectrophotometer device. The DPPH inhibition percentage (I %) was evaluated by using the formula, **DPPH Inhibition % = {Abs (Control) – Abs (Sample)} / Abs (Control) x 100.** Gallic acid was taken as standard and dimethyl sulfoxide (DMSO) was used for the negative control. All determination was done in triplicate.

Phytochemical profiling of the root extracts

HPLC

HPLC analysis was performed with the use of HPLC- Agilent 1260 infinity. Hi-Olex H 300 X 7.7MM, 8µ column was used with a flow rate of 0.7ml/min. The column and detector temperatures were maintained at 60°C and 55°C respectively. 10 µl of the respective sample was injected into the column. Gallic acid was the standard compound used. The UV detector was employed to detect light at 272nm.

Gas Chromatography-Mass Spectroscopy (GC-MS):

The HP-5MS, 30mX250µm; 0.25µm column was used to perform GC-MS analysis on ethyl acetate, methanol, and aqueous extract with the flow rate of 1ml/min with 250°C inlet temperature, and the carrier gas was helium. The holding time was 1-10minutes, the temperature value was 60°C-250°C and the runtime was between -20°C/min. 1:10 was the split ratio, with 280°C transfer line temperature, 250°C Ion source temperature, Scan range was from 40-500amu and the injection volume was 1µl for respective samples Commercial library (NIST) was used to recognize the different components in the extracts.

RESULTS

Plant samples extraction

Extraction of *Bergenia ciliata* root was done by Soxhlet extraction procedure using three different solvents i.e., ethyl acetate, methanol, and aqueous according to the increasing polarity. The different solvent extracts were presented as T1 for ethyl acetate, T2 for methanol, and T3 for aqueous. The yield is mentioned in the given Table.1

Antibacterial activity (NCCLS 1993)

For determining the antibacterial activity, Agar well diffusion method was used. The antimicrobial sensitivity test results had shown profound efficiency of the extracts equated to the standard drugs. T2 has shown the highest antibacterial activity against the selected organisms (*Pseudomonas aeruginosa, Klebsiella pneumonia, Acinetobacter baumannii)* with the maximum zone of inhibition (mm), while the least activity was shown by T3 with compared to the standard drugs (Cefoperazone + Sulbactam) zone of inhibition (mm). *Pseudomonas aeruginosa (*MTCC 647) growth was observably inhibited by the standard drugs with ZOI of 24mm for 0.5mg/100µl and 32mm for 1mg/100µl. T1 has shown clear sensitivity towards it with ZOI of 13mm for 0.5mg/100µl and 21mm for 1mg/100µl, T2 has tremendously suppressed the bacterium growth with ZOI of 17mm for 0.5mg/100µl and 23mm for 1mg/100µl. T3 bactericidal activity is quite less with ZOI of 14mm and 22mm for 0.5mg/100µl, 1mg/100µl respectively. The effectiveness of the standard drug for *Klebsiella pneumonia* (MTCC 618) was detected with ZOI of 22mm of 0.5mg/100µl and 29mm of 1mg/100µl. For which T2 has shown remarkable bactericidal effect with ZOI of 17mm of 0.5mg/100µl and 25mm of

1mg/100µl which is followed by T1 antibacterial activity with the ZOI of 15mm of 0.5mg/100µl and 20mm of 1mg/100µl and T3 with ZOI of 16mm of 0.5mg/100µl and 23mm of 1mg/100µl, For *Acinetobacter baumannii*, the ZOI of the standard drug was 24mm of 0.5mg/100µl and 33mm of 1mg/100µl. The sensitivity of T3 extract was measured with ZOI of 18mm for 0.5mg/100µl and 24mm for 1mg/100µl. T2 inhibited bacterial growth with ZOI of 20mm of 0.5mg/100µl and 25 of 0.5mg/100µl while T1 sensitivity to the bacterium was with ZOI of 17mm of 0.5mg/100µl and 22mm 0f 1mg/100µl. All the observations were dose-dependent (Table: 2,3,4,5). The minimal inhibitory concentration and minimum bactericidal concentration were also observed. (Table: 6,7,8). Table 2: Antimicrobial activity of Control against MDR- CRO (Carbapenem-Resistant Organisms) pathogens.

DPPH Radical Scavenging Assay

For evaluating the antioxidant capacity, the DPPH assay was used for this purpose. This method was simple and easy to demonstrate. The scavenging activity was observed by the DPPH solution colour change from violet to yellow due to electron transfer. It is a stable free radical at room temperature and in the presence of an antioxidant molecule it gets reduced and form a colourless ethanol solution. In numerous studies, it's been ascertained that the extracts from medicinal plants can shield the DNA from damage due to the presence of these antioxidant components in them **[21].** According to **R** Kumar **V et.al., 2010 [7],** both the methanolic (T2) and aqueous (T3) extracts of ***Bergenia ciliata*** have the antioxidant capacity as both are active radical scavengers**.** In our study, it was observed that all the root extracts had shown concentration-dependent antioxidant activity but ethyl acetate (T1) extracts have the maximum inhibition % which is followed by aqueous extracts inhibition %. Methanol extracts has shown the minimum inhibition%. The observation was compared with Gallic acid as it was used as the standard compound. Below is the table (Table.9) and graphic representation: Fig: 3 Table 9: Reducing Antioxidant power of *Bergenia ciliata* root extract in different solvents along with standard compound (gallic acid).

Phytochemical Screening

Phytochemical screening of the *Bergenia ciliata* root extracts was done by the GC-MS technique. The results had shown the presence of plenty of secondary metabolites. The study revealed that there was the presence of hydroquinone (benzenoids), (+) afzelechin, (+) bergenin, arbutin, catechin, phenolic compounds, reducing sugars, gallic acid, and tannin. flavonoids, glycosides, sterols, terpenoids, Acetic acid, nonadienal, hexanoic acid, pentanoic acid, Methyl nonanoic, β-phellandrene, parasorbic acid, asarone, and β-caryophyllene and many more phytochemicals [22]**.** It has been observed in many studies that the presence of secondary metabolites in the plants are responsible for their pharmacological activity [23,24]**. According to Ahmad et.al., 2018 [10]gallic acid, asarone,** Para sorbic acid, afzelechin, and β-caryophyllene possess antimicrobic activity. Studies had testified that the alkaloids (Hexanal, pentanol) have a spasmolytic, antimalarial, painkilling, and diuretic activities; Terpenoids (glucosides, camphor, β-phellandrene) are known for their antibacterial, anticancer, anthelminthic, antimalarial, antiviral, anti-inflammatory properties; Glycosides (arbutin) are observed for antibacterial and antifungal properties; Phenols (gallic acid, tannic acid, bergenin) and flavonoids (afzelechin) have examined for its antiallergic, antibacterial, antioxidant properties, anti-inflammation, anticancerogenic activities,etc. and Saponins have widely associated with anti-inflammatory, antiviral, plant defence activities [25,26]**.**Carboxylic acid (Pentanoic acid, Hexanoic acid) has therapeutic activities in them. **(**-)-3-O-galloylepicatechin and (-)- 3-O-gallocatechin showed strong inhibitory action against α- glucosidase and α- amylase. HPLC technique was used to determine the presence of the major phytochemical compound Gallic acid. It is the derivative of bergenin. Below are the table showing the result for HPLC with chromatogram (Fig:4) and the list of phytochemicals for GCMS (Table: 10,11,12) with chromatogram (Fig: 5,6,7) as well:

HPLC

Fig: 4. HPLC Chromatogram obtained from T2 extract of *Bergenia ciliata* showing a prominent peak of Gallic acid as the major compound.

Gas Chromatography-Mass Spectroscopy (GC-MS):

Table 10: Phytochemicals constitute in T1 extract using GC-MS technique. Fig: 5. The GC chromatogram of the T1 extract. Table11: Phytochemical constitutes in T2 extract using GC-MS technique. Fig: 6. The GC chromatogram of T2 extract. Fig: 7. The GC chromatogram of the T3 extract. Table 12: Phytochemicals constitutes in T3 extract using GC-MS technique**.**

DISCUSSION

Over decades, many succeeding discoveries of a wide range of antibiotics had been made and with that its resistance also had become subsequent. Microbial tolerance to antimicrobial agents is a growing phenomenon and there are no new drugs to replace it [27,28]. Carbapenem (meropenem, doripenem) are the latest discovered antibiotic with a broad spectrum of activity. It has shown noticeable effects in treating many hospitals acquired infections. But increased consumption of carbapenem can jeopardize its effects in modern medicine techniques. Therefore, there is an urgent need to search for new alternatives which can be used for therapeutic purposes. The herbaceous plants were being utilized and exploited by a human for decades. In Ayurveda, the plants were used as herbal formulations because of their different pharmacological properties. In the present scenario, the growing antibiotic resistance among bacteria has become a serious threat to human life. This may be due to the abrupt, indiscriminate, and overuse of drugs. Nowadays people have made antibiotics a part of their daily routine which somewhere affected the effectiveness of drugs as bacteria are becoming more exposed to them. Therefore, making themselves resistant by altering their compositions, gaining mutations, etc. In our study, we focused on evaluating the pharmacological activities of *Bergenia ciliata* root. Crude extracts with chemicals were firstly prepared and then subjected to the evaluation of phytochemicals, antioxidants, and antimicrobic activities. The extracts scavenging potential leads to their antioxidant property. Based on the scavenging effect of extracts, the antioxidant activity was evaluated. DPPH method was used. It is a sensitive approach for determining the reducing capacity of plant extracts **[29,30].** All the root extracts (ethyl acetate, methanol, aqueous) had shown antioxidant activities. According to many studies, the chemical constituents such as steroids, terpenoids, tannins, and flavonoids present in the plants are responsible for their antioxidant activity **[7].** This research shows that the methanolic fractions of *Bergenia ciliata* can be used as a precursor to pharmaceutical drugs. Our present results also showed a strong zone of inhibition of different extracts against *P.aeruginosa, A.baummannii*, and *K. pneumonia*. **Rajbhandari et.al.,** [31] have observed the presence of sterols, glycosides, and many other phytochemicals which is responsible for the antibacterial effects of the genus Bergenia.

CONCLUSION

The present study sightsees thorough information about *Bergenia ciliata* and its medicinal potency against the carbapenem-resistant organism. The biological, pharmacological, and phytochemical investigation of *Bergenia ciliata* root reports the pliability and diversity of this plant. This plant has been used for ages for its therapeutic purposes to treat many human afflictions. In our study, we are using it to treat prominent carbapenem-resistant organisms which are often responsible for causing some serious respiratory infections in humans. The results obtained through the work are employed to conclude the effectiveness and efficiency of the root extracts used against these MDR-CRO. The methanolic root extract has shown prominent antimicrobial effect against each test organism while the least activity was observed in ethyl acetate root extract. DPPH assay additionally helped in examining the antioxidant capacity of the extracts in which methanolic root extract has shown the significant scavenging activity in it. With the assistance of the GS-MS technique, the study also revealed the presence of an ample number of chemical compounds with totally different kinds of antimicrobial activities in the extracts which further can be used to make new antimicrobial drugs for therapeutic purposes. Herbal medicine has become an intact part of the medicinal system for a long time and being such an effective herbal formula, proper documentation is required to untap the unrecognized properties of *Bergenia ciliata* . Also, there is such a large number of aspects remaining concerning this plant that

requires to be studied further. Therefore, in near future, in vivo studies shall be carried out to analyse the adopted specific mode of action of the plant extracts to suppress the activity of MDR CRO organisms.

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Table 1: Yield of *Bergenia Ciliata* root extracts in various solvents.

The yield, yield% and physical properties of *Bergenia Ciliata*			
Solvent used	**Ethyl acetate (T1)**	**Methanol (T2)**	**Aqueous (T3)**
Yield (gm/250ml)	8.33gm	12.25gm	7.89gm
Colour	Brown	Dark brown	Dark brown
State	Liquid	Viscous	Viscous
Yield%	27.76%	40.83%	26.3%

Table 2: Antimicrobial activity of Control against MDR- CRO (Carbapenem-Resistant Organisms) pathogens.

S.NO.	**Concentration of Extract**	***Pseudomonas aeruginosa***	***Klebsiella pneumoniae***	***Acinetobacter baumanii***
1.	0.5mg	24	22	24
2.	1mg	32	29	33

Table 3: Antimicrobial activity of T1 against MDR-CRO pathogens.

S.NO.	Concentration of Extract	*Pseudomonas aeruginosa*	*Klebsiella pneumoniae*	*Acinetobacter baumanii*
1.	0.5mg	13	15	17
2.	1mg	21	20	22

Table 4: Antimicrobial activity of T2 extract against MDR- CRO pathogens.

S.NO.	Concentration of Extract	*Pseudomonas aeruginosa*	*Klebsiella pneumoniae*	*Acinetobacter baumanii*
1.	0.5mg	17	17	20
2.	1mg	23	25	25

Table 5: Antimicrobial activity of T3 against MDR- CRO pathogens.

S.NO.	Concentration of Extract	*Pseudomonas aeruginosa*	*Klebsiella pneumoniae*	*Acinetobacter baumanii*
1.	0.5mg	14	16	18
2.	1mg	22	23	24

Table 6: The values of Minimum inhibitory concentration assay and Minimum bactericidal concentration assay of T1 extract against MDR-CRO.

The MIC, MBC, and MIC Index values						
Organism	**Incubation period**	**Minimum inhibitory concentration (0.5mg/100ml)**				
		Range	**MIC (Control)**	**MIC (T1)**	**MBC (T1)**	**MIC Index**
Pseudomonas aeruginosa (MTCC 647)	37°C	0.5-0.0156	0.0156	0.0312	0.0156	0.5
Klebsiella pneumonia (MTCC 618)	37°C	0.5-0.0156	0.0156	0.0625	0.0312	0.5
Acinetobacter baumannii (MTCC 9829)	37°C	0.5-0.0156	0.0156	0.0312	0.0156	0.5

Table 7: The values of Minimum inhibitory concentration assay and Minimum bactericidal concentration assay of T2 extract against MDR-CRO.

The MIC, MBC, and MIC Index values						
Organism	**Incubation period**	**Minimum inhibitory concentration (0.5mg/100ml)**				
		Range	**MIC (Control)**	**MIC (T2)**	**MBC (T2)**	**MIC Index**
Pseudomonas aeruginosa (MTCC 647)	37°C	0.5-0.0156	0.0156	0.0625	0.0312	0.5
Klebsiella pneumonia (MTCC 618)	37°C	0.5-0.0156	0.0156	0.0312	0.0156	0.5
Acinetobacter baumannii (MTCC 9829)	37°C	0.5-0.0156	0.0156	0.0625	0.0312	0.5

Table 8: The values of Minimum inhibitory concentration assay and Minimum bactericidal concentration assay of T3 extract against MDR-CRO.

The MIC, MBC, and MIC Index values						
Organism	**Incubation period**	**Minimum inhibitory concentration (0.5mg/100ml)**				
		Range	**MIC (Control)**	**MIC (T3)**	**MBC (T3)**	**MIC Index**
Pseudomonas aeruginosa (MTCC 647)	37°C	0.5-0.0156	0.0156	0.0312	0.0156	0.5
Klebsiella pneumonia (MTCC 618)	37°C	0.5-0.0156	0.0156	0.0312	0.0156	0.5
Acinetobacter baumannii (MTCC 9829)	37°C	0.5-0.0156	0.0156	0.0625	0.0312	0.5

Table 9: Reducing Antioxidant power of *Bergenia ciliata* root extract in different solvents along with standard compound (Gallic Acid)

S.NO	**Concentration (mg/µl)**	**Inhibition% ± SD (n=3)**			
		Standard (Gallic acid)	Ethyl Acetate	Methanol	Aqueous
1	25	94.23%±0.001	69.91%±0.005	67.10%±0.002	67.49%±0.003
2	50	94.54%±0.002	73.81%±0.001	67.57%±0.003	67.65%±0.004
3	75	95.08%±0.003	74.35%±0.001	67.42%±0.009	68.35%±0.002
4	100	95.55%±0.003	74.82%±0.002	69.21%±0.004	69.21%±0.004
5	125	95.86%±0.002	74.98%±0.001	69.60%±0.001	69.99%±0.001
6	150	96.64%±0.002	76.30%±0.004	69.91%±0.005	71.62%±0.004
7	175	96.88%±0.002	76.38%±0.001	70.30%±0.007	74.27%±0.005
8	200	97.11%±0.002	77.00%±0.003	73.81%±0.005	75.83%±0.001
9	225	97.42%±0.002	77.00%±0.004	75.60%±0.001	76.07%±0.003
10	250	97.81%±0.003	78.64%±0.003	76.92%±0.002	76.61%±0.002

The mean ± SD values are in triplicates

Table 10: Phytochemicals constitute in T1 extract using GC-MS technique.

S.NO	**RT**	**Peak**	**Compounds with IUPAC names**
1	3.102	0.68	Diglycolic acid, dl-Glyceraldehyde, DL-Xylose
2	3.626	0.75	2-Propanone. 1,3-dihydroxy-, dl-Glyceraldehyde dimer, Hydroxyacetic acid, hydrazide
3	4.302	2.22	Glycerine, Diglycerol
4	4.383	1.23	2,4-Dihydro-2,5-dimethyl-3(2H)-furan-3-one, 1,3-Dioxolane-4-, ethanol,2,2-methyl-(S), Isosorbide Dinitrate
5	5.258	9.00	2-Cyclohexen-1-one, 2-Azabicuclo {2.2.1} heptane, 2-Cyclohexen-1-one
6	5.360	2.69	1,2,3-Propanetriol, monoacetate, Hexanoic acid, 3-hydroxy-methyl ester Pentanoic acid, 3-hydroxy-methyl ester
7	5.760	1.51	Galacticcellulosee, d-Glycerol-d-ido-heptose, 3-Amino-2-oxazolidinone
8	6.111	0.53	Cyclopropanecarboxamide, 2-furan-1,3-dimethyl1-1, 30diazaphosphole, 1-thioxide, 3-Decyn-2-ol
9	6.273	0.63	Phenol, 2-ethoxy-, 1,2-Benzenediol, Resorcinol
10	6.446	0.39	Benzofuran, 2,3-dihydro-, Glycine, N-{phenylmethyl}-
11	6.635	0.45	1,2,3-Propanetriol, Monoacetate, Diacetate
12	6.976	0.81	3(2H)-Pyridazinone, 6-methyl-, 2-Amino-3-hydroxy pyridine

			1H-Pyrrole-2, 5-dione, 1-ethyl-
13	7.548	3.75	N-Hydroxycarbamic acid, 2-(propoxycarbonylamino)ethyl ester Propane, 2-(ethenyloxy)-, Phenol, 4-(2-aminopropyl)-
14	8.018	0.40	Phenol, 2,6-dimethoxy-, 5-Isopropyp-2,4-dioxo-1, 3,4- etrahydropyrimidine, Phenol, 3,4-dimethoxy-
15	8.267	4.38	Phenol, 4-propyl-, Benzenemethanol, alpha-ethyl- Ethyl 2—hydroxybenzyl sulfone
16	8.348	9.03	1,2,3-Benzenetriol
17	9.293	0.81	2-Penten-old, (E)-, Dihydroxymaleic acid, Piperazine
18	10.336	0.67	Benzamide, 4-butoxy-N-(2-(thionyl) ethyl)-, D-Mannopyranose Alpha-d-Riboside, 1-0-dodecyl-
19	10.541	0.37	3(2H)-Benzofuranone, 5-methyl-, 3,4-Dihydro-2-quinoxaline
20	10.843	7.72	Benzoic acid, 4-hydroxy-, Propylparaben
21	12.037	0.36	Benzoic acid, 4-hydroxy-3-methoxy- 3-Hydroxy-4-methoxy benzoic acid
22	12.378	0.56	Z-8-Hexadecene, Cyclohexadecane, 2,4-Pentadien-1-ol, 3-propyl-(2Z)-
23	12.648	0.92	1,3,5-Benzenetriol, dihydrate
24	12.875	1.21	Acetaldehyde, (phenylthiol)-, 3-Heptyne, 5,5-diethyl 1H-Pyrazole-1-acetic, 3,5-dimethyl, alpha, -(2-oxo-2-, phenylethyl)-
25	14.571	0.44	Benzoic acid, 4-hydroxy-
26	16.626	0.79	Benzoic acid, 4-hydroxy-3, 5-dimethoxy
27	17.936	4.23	n-Hexadecanoic acid, Tridecanoic acid
28	19.611	0.36	Cyclopentadecane, Cyclohexane, 1,1-(2-ethyl-1-3-propanediyl) bis- Cyclohexane,1,1-(2-methyl-1,3-propanediyl)bis-
29	20.454	2.55	9,12-Octadecadienoic acid (Z, Z)-, Methyl 9,12-heptadecadienoate 9,12-Octadecadienoic acid (Z, Z)-
30	20.518	3.65	Trans-13-Octadecenoic acid, Cis-Vaccenic acid 6-Octadecenoic acid
31	20.805	13.23	2H-1-Benzopyran-2-one, 7,8-dihydroxy-6-methoxy-,2-Allyl-3-ethoxy-4- methoxyphenyl, Imidazo{5,4-e} [1,4] diazepine-4, 7-dione,1,5,6,8-tetrahydro-, 1,5,8-trimethyl-
32	22.825	0.42	9-Tricosene(Z)-, 1-But-1-enylaziridine 1,9-Tetradecadiene
33	25.531	0.76	Cyclohexane, 1-(cyclohexylmethyl)-, 4-ethyl-cis- Hexahydropuridine, 1-methyl-4-{4,5-dihydroxyphenyl}- 2-[cetoxymethyl]-3-(methoxycarbonyl) biphenylene
34	25.845	0.50	2-Ethylacridine, Benzo (h) quinoline, 2,4-dimethyl- N-Methyl-1-adamantaneacetamide
35	26.536	0.62	4H,6H-1,3,5-Triazino (2,1,b), 1,3,4-thiadiazine-2-amine, 7-(4-chlorophenyl)-4- imino-, Benzene, 1-ethoxy-4-[(4-pentylphenyl) ethynyl}- Pyrido (2,3-dipyrimidine, 4-phenyl-
36	26.930	0.67	2-Ethylacridine, Benzo(h) quinoline, 2,4-dimethyl- 1,4-Naphthoquinone, 2-acetyl-3, 8-dihydroxy-5, 6-dimethoxy-
37	27.811	1.64	Hexahydropyridine, 1-methyl-4-(4,5-dihydroxyphenyl)- Silane, 1,4-phenylenebis (trimethyl) Trimethyl {4-[2-methyl-4-oxo-2-pentyl] phenoxy} silane
38	30.096	1.20	Benzo(h) quinoline, 2,4-dimethyl-, Propiophenone,2- (trimethylsiloxy)-
39	36.276	2.15	2-(Acetoxymethyl)-3-methoxycarbonyl) biphenylene

			Anthracene,9,10-diethyl-9-9-10-dihydro-, Anthracene,9,10-dihydro-9,9-10-trimethyl-
40	38.545	15.71	γ -Sitosterol, β-Sitosterol

Table11: Phytochemical constitutes in T2 extract using GC-MS technique.

S.NO	RT	Area	Compounds with IUPAC names
1	2.206	0.45	Cyclopropyl carbinol, o-Methylisourea hydrogen sulfate 2-Butanamine
2	2.622	0.53	N-Methyl-N-{2-cynoethyl}-2-mercapto, Propylamine Cycloserine, o-Methylisourea hydrogen sulfate
3	2.692	0.45	Guanidine, methyl-Oxirane, 2,3-dimethyl-cis, alpha- D-Mannopyranoside, methyl 3,6-anhydrous-,
4	3.103	1.72	Diglycolic acid Methenamine, N-hydroxy-n-methyl
5	3.205	1.05	Furfural 3-Furaldehyde
6	3.340	0.51	2-Furanmethanol Levoglucosenone
7	3.508	0.57	Dihyro-2-{3H}-thiophene Propanoic acid, 2-oxo, methyl ester 2-Thiazolamine, 4,5-dihydro-
8	3.621	2.77	1,2-Ethanediol 2-Propanone, 1,3-dihydroxy- 1,3-Dihydroxyacetone dimer
9	4.286	0.58	1,2,3,4-Butanetetrol, {S- [R, R]}- 1,2-Ethanediol, 1- {2-phenyl-1,3,3-Dioxaborolane-4-yl-, {S-[R, R]- 2(R), 3(S)-1,2,3,4-Butanetrol
10	4.442	0.89	2,4-Hexadienoicacid, methyl ester, (E, E)- 2,4-Octadienoic acid, 7-hydroxy-Methyl ester, {R-(E,E)}-
11	5.074	0.54	2-Oxabicyclo {3,2,0} hepta-3,6-diene Cyclopropanecarboxamide
12	5.258	17.69	2{1H}-Pyridinone, 6-hydroxy- 2H-Pyran-2-one, 5,6-dihydro- 2{1H}-Pyridinone, 6-hydroxy-
13	5.750	0.76	3,4-Furandiol, tetrahydro- trans- 3,4-Furandiol, tetrahydro- cis 3-Amino-2-oxazolidinone
14	5.831	2.11	4H-Pyran-4-one, 2,3-dihydr-3, 5-dihydroxy-6-methyl-
15	5.906	1.32	2[5H]-Thiophenone 2-Propanone, dimethylhydrazine Pentanoic acid, 3,3-dimethyl-4-semicarbazono-
16	6.274	0.69	1,2-Benzenediol
17	6.441	1.07	Benzaldehyde, 3-methyl- 1,2-Benzisoxazole
18	6.554	3.76	2-Furancarboxaldehyde, 5- {hydroxym ethyl}- 2-Propyn-1-amine, N, N-di-propyny 1- 2-Butenal
19	6.608	2.69	1,4-Pentanediol Pentanedioic acid, 2-methyl- 4-Nonanone, 9-methoxy-
20	6.679	0.52	Pentanoic acid, 3-hydroxy-4-methyl-, methyl ester Propanal, 2,3-dihydroxy-, (S)- Hydroperoxide, 1-methyl butyl
21	6.987	1.54	3(2H)-Pyridazinone, 6-methyl- Hydroquinone Cyclohexanone, 4-methylidene-
22	7.127	0.75	4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl- 1,3-Dioxolane-4-methanol, alpha Ethynyll-2,2-dimethyl-, acetate 2,4,6,8-Tetraazabicyclo {3,3,0} octan-3-one, 7-nitroimino-
23	7.392	0.43	1H-1,2,3-Triazole-1,5-diamine, 3-nitro- 3-Butenamide Guanidine, N, N-Dimethyl-

24	7.548	1.94	Oxalacetic acid Azetidine-2-one, 3,3-dimethy; -4{1, aminoethyl}- 2-Oxopropionic acid, dimethylhydrazine, methyl ester
25	7.813	0.73	Phenol, 4-{2-propenyl}-, acetate Benzaldehyde,2,4-dimethyl- Benzaldehyde,2,5-dimethyl-
26	8.029	1.16	Phenol,2,6-dimethoxy- Phenol,3,4-dimethoxy-
27	8.261	2.71	Phenol, 2-propyl- Furan, 2-{1-pentenyl}-, (z)- Benzeneacetic acid, 4-hydroxy-, methyl ester
28	8.359	23.15	1,2,3-Benzenetriol
29	9.650	6.07	D-Galactonic acid, gamma-lactone D-Erythro-Pentose, 2-deoxy- Propanoic acid, 3-hydroxy-, hydrazide
30	10.417	1.14	L-Lyxose D-Galactose, 6-deoxy-D-Mannoheptulose
31	10.838	3.02	Benzoic acid, 4-hydroxy-
32	11.605	1.40	Cyclopentanecarboxylic acid, 2-tetradecyl ester, cyclopentyl ester Cyclopentanecarboxylic acid, 3-tetradecyl ester
33	12.432	0.82	Piperidine-2-one-5-carboxylic acid, 1-Silacyclo-2,4-hexadiene 5-Hydroxy-2-methylthiopyrimidine
34	12.880	1.29	Benzeneacetic acid, 3,4-dihydroxy- Phenol, 2-amino-5-methyl- 2,4-Pyridinedicarboxylic acid
35	13.080	4.10	Silver butanoate Trans-1, 10-Dimethyl-trans-9-decalinol 2-Pyridianamine, 5-fluro-
36	16.154	0.90	4H-1-Benzothiopyran-4-one,2,3-dihydro- Allopurinol
37	16.278	1.85	Benzoic acid, 4-hydroxy-3,5-dimethoxy-
38	17.088	0.44	Benzoic acid, 4-fluro-3-methoxy-methyl ester Benzoic acid, 3,4,5-trihydroxy-methyl ester Benzoic acid, 2-fluro-3-methoxymethyl ester
39	17.488	0.51	Pentadecanoic acid, 14-methyl-methyl ester€- Hexadecanoic acid, methyl ester
40	17.920	1.18	n-Hexadecanoic acid Tridecanoic acid
41	19.876	0.44	9-Octadecanoic acid, methy ester €-6-Octadecanoic acid, methyl ester (EZ)- 10-Octadecanoic acid, methyl ester
42	20.437	0.69	3-Octadecyne 3-Hexadecyne 9,12-Octadecadienoic acid (Z, Z)-
43	20.783	1.10	3,5-Dimethoxy-4-hydroxycinnamaldehyde 2H-1-Benzopyran-2-one,7,8-dihyroxy-6-methoxy- 2,4,7-Pteridinetriol, 6-ethyl-
44	20.859	0.60	Phenanthrene, 2-methoxy- Pyrene, 1,2,3,6,7,8-hexahydro-
45	38.534	1.37	Propiophenone, 2-{trimethylsiloxy}- 2-Methyl-7-phenylindole Trimethyl{4-tert,-butylphenoxy} silane

Table 12: Phytochemicals constitutes in T3 extract using GC-MS technique.

S.NO	RT	Peak	Compounds with IUPAC names
1	2.195	1.49	2-Propanone, 1-hydroxy-Ethylamine Propanoic acid, 2-oxo-
2	2.697	0.53	o-Methylisourae hydrogen sulfate N-Methoxy-1-ribofuranosyl-4- imidazolecarboxylic amide Ethyl aminomethylformaimidate
3	2.838	0.50	Cyclopropyl carbinol 2{3H}-Furanone, dihydro-4-hydroxy- 3-Amino-2-oxazolidinone

4	2.951	0.38	Cyclopropyl carbinol, 5-Aminoisoxazole Cyclopropyl carbinol
5	3.194	0.79	3-Furaldehyde, Furfural
6	3.286	0.88	Dimethyl Sulfoxide Pyrimidine-4,6(3H,5H)-dione,2-butylthio--
7	3.335	2.51	2-Furanmethanol
8	3.502	0.64	2(3H)-Furanone, dihydro-4-hydroxy- Propanenitrile, 3-(methylamino)- N, N-Dimethyl-dimethyl phosphoric amide
9	3.632	1.64	1-Butanol, dl-Glycealdehyde dimer 1,2-Ethanediol, monoformate
10	3.929	21.74	2-Cyclopenten-1-one, 2-hydroxy-, 4H-1,2,4-Triazole-3-amine,4-methyl 1,3-Cyclopentanedione
11	4.102	0.75	Allene, 2,5-Furandione, 3-methyl-, 2H-Pyran-2-one
12	4.388	6.07	1,2-Ethanediol,1-{2-phenyl-1,3,2-dioxaborolan-4-yl},- (S-(R,R)}- 2(R),3(S) – 1,2,3,4-Butanetetrol, 1,2-Propanediol, 3-chloro-
13	4.556	2.10	2H-Pyran-2,6 (3H)-dione, 2-Pentenal, (E)-
14	4.712	0.74	N-Methoxy-1-ribofuranosyl-4-imidazole polycarboxylic amide Asparagine, DL-Propanedioic acid, propyl-
15	4.896	0.44	Propanal, 2-methyl-, dimethylhydrazine 2,4,5-Trioxoimidazolidine
16	5.074	1.52	2(1H)-Pyrimidinone, 1,1-Cyclopropanedicarboxamide Thiocyanic acid, 2-propynyl ester
17	5.263	11.62	2H-Pyran-2-one, 5,6-dihyro-, 2-Cyclohexene-1-one 2-Azabicyclo (2.2.1) heptane
18	5.609	1.00	2H-Pyran-2-one, Cyclopropanecarboxamide 1H-Pyrazole, 1-vinyl-
19	5.766	0.61	N-Aminomorpholine, Pterin-6-carboxylic acid Cycloserine
20	5.836	1.60	4H-Pyran-4-one,2,3-dihyro-3,5-dihydroxy-6-methyl- 2,4-Dihydro-2,5-dimethyl-3 (2H)- Furan-3-one
21	5.922	0.65	Cyclopropyl carbinol, Propanamide, N-{1-cyclohexylethyl} 1-Methyl-2-phenethylamine
22	6.046	0.35	Chlorodifluoroacetamide, Cycloserine N-methyl-N-{2-cyanoethyl}-2- mercaptan
23	6.122	0.48	1,2,3,4-Butanetetrol, {S-[R, R]}-, 3,4-Furandiol, tetrahydroxy-, cis- 2R,3S-9-{1,3,4-Trihydroxy-2-hutoxy methyl} guanine
24	6.273	0.90	1,2-Benzenediol
25	6.452	0.38	2-{4,5-Dihydro-3-methyl-5-oxo-1-phenyl-4-pyrazolyl}-5-nitrhbenzoic acid 2-Butenediamide, (E)-, 4-Aminobutyramide, N-methyl-N-{4-[1-pyrrolidinyl}-2-butynyl]-N,N-bis (trifluproacet)-
26	6.560	2.58	3-Methyl-2-furoic acid, 1-Methoxy-1-buten-3-one 2H-Pyrano [3,2-b] pyridine
27	6.943	0.47	o-Methylisourea hydrogen sulfate, Pterin-6-carboxylic acid N-(3-Methylaminolropyl)- N-dimethylformamide
28	7.116	1.67	Benzene, 1-ethynyl-4-nitro-, Pyruvic acid, ethyl ester, 2-(thiosemicarbazone) 2-Thiophenethiol
29	7.397	0.70	N-Acetyl-1-methioninamide, Glycoside, 1-cyno- 1,2-Propanediol, 3-chloro-
30	7.559	8.41	Propane, 2-[ethenyloxy]-, Acetic acid, 2-{N-methyl-N-phosphonatomethyl} amino-, Butanal, 3-methyl-

31	7.802	0.70	Carbamic acid, ethyl-, methyl ester, N-Methyl-N-{2-cyanoethyl}-2-mercapto propylamine, Acetamide, 2-cyano-
32	8.040	0.51	Phenol, 2,6-dimethoxy-
33	8.369	7.85	1,2,3-Benzenetriol
34	8.715	0.35	4-Methlimidazole-2-5-ethanol 3-Methyl-3,5-{cyanoethyl}tetrahydro-4-thiopyranone Methanesulfonamide, N, N-dimethyl-
35	9.477	0.43	{2,2-Dicholrocyclopropyl} methanol 2-Formyl-9- [beta-d-ribofuranosyl] hypoxanthine Cyanoacetylurea
36	10.330	5.11	3-Furanacetic acid, 4-hexyl-2,5-dihydro-2, 5-dioxo- 1-Amino-2-acetamido-3- fluorobenzene Guanethidine
37	10.811	1.40	Benzoic acid, 4-hydroxy-
38	11.189	0.72	5-Oxazolecarboxamide, 4-methyl- 1- [{3, s-Hydroxy-2 R-butoxymethyl} thymine, 1,3-cyclic phenyl phosphonate 2-Butenal, 2-methyl-, dimethylhydrazine
39	12.243	0.88	2-Formyl—{beta-d-ribofuranosyl} hypoxanthine D-Allose, Ethyl, alpha-d-glucopyranoside
40	12.950	4.15	1H-1,2,4-Triazole-3-amin,1-ethyl-, Pyrazole-5-carboxylic acid Hexane, 3-methyl-
41	14.538	0.77	Cyclohexanone, dimethylhydrazone, 4-[5-Carboxy-furan-2-ylmethyl]-carbamoyl}-furan-3-carboxylic acid, 7-Methl-oxa-cyclododeca-6, 10-diem-one
42	15.802	0.52	Furazanamine, 4-azido-, 1,9-Diazaspiro (4,4) nonane-2,8-dione 2(1H)-Pyridinone, 3-methyl-5-nitro
43	16.272	0.36	2-Nitro-4-amino-1,5-dimethoxybenzene, 1,5-Naphthyridine, 2,6-dichlo-alpha-{1-Indanylidene} cyanoacetmide
44	17.083	0.75	Benzoic acid, 4-fluro-3-methoxymethyl ester Benzoic acid,3,4,5-Trihydroxy-methyl ester
45	20.788	1.35	Naphthalene, 2-{1-cyclohexane-1-yl}, 3,5-Dimethoxy-4-hydroxycinnamaldehyde, 1,4-Anthracenedione

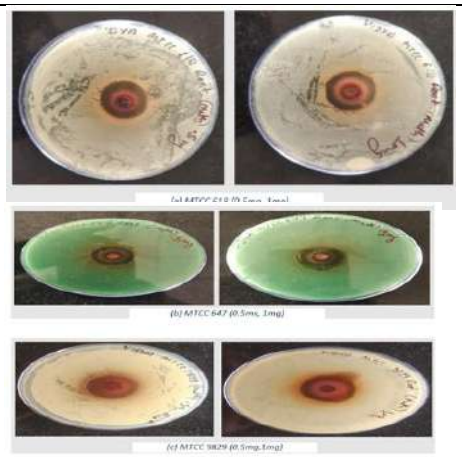

Fig: 1. The Highest Zone of Inhibition shown by Methanol root extract for all the MDR-CRO pathogen with the concentration of 0.5mg/100µl, 1mg/100µl (a. *MTCC618*, b. *MTCC647*, c. *MTCC9829*).

Fig: 2. Minimum inhibitory concentrations of Methanol extract (0.5mg/100µl) for all the MDR-CRO pathogens.

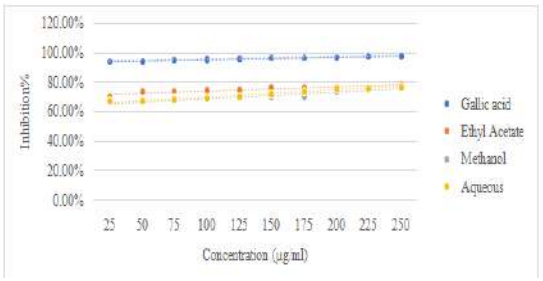

Fig 3: Graphical representation of antioxidant capacity of various (T1, T2, and T3) extracts of *Bergenia Ciliata root* at increasing concentration with Gallic acid as reference compound.

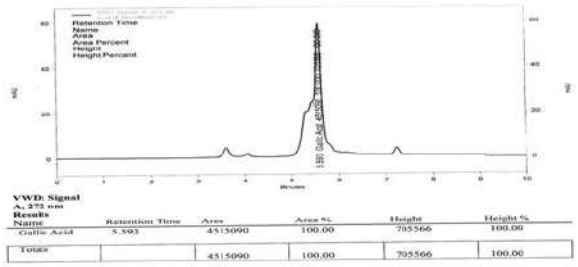

Fig: 4. HPLC Chromatogram obtained from T2 extract of *Bergenia Ciliata* showing a prominent peak of Gallic acid as the major compound.

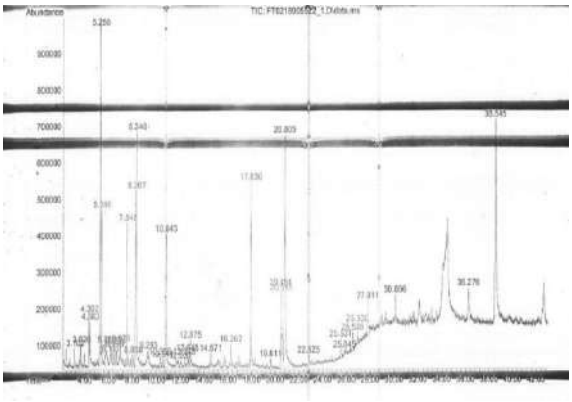

Fig: 5. The GC chromatogram of the T1 extract

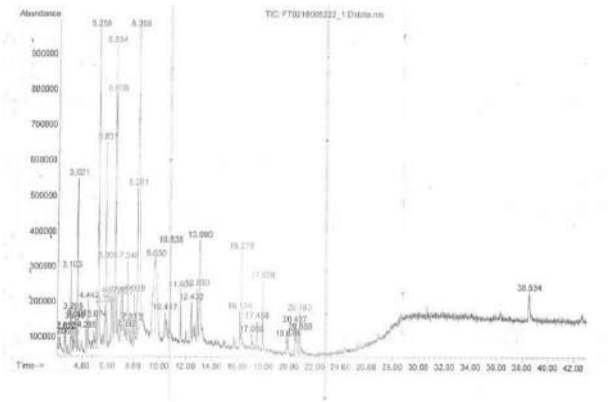

Fig: 6. The GC chromatogram of T2 extract

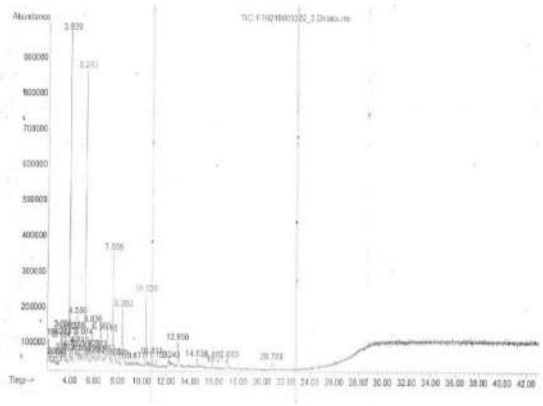

Fig: 7. The GC chromatogram of the T3 extract

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RESEARCH ARTICLE

Case Study on Veera Narayana Agricultural Farmer Producer Company Ltd and It's New Farm Research and Extension initiatives and Interventions with Annamalai University

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ABSTRACT

The New on Farm Research Interventions and Extension Initiatives of Veera Narayana Agricultural farmer producer company in association with Farmer's Agricultural Technology Information Cell (FATIC), Annamalai University is expected to cultivate native folk variety "Country Basmati" with Annamalai University Integrated Farming System at farmer fields. This initiative is expected to be climate resilient in nature, generate more income to our farming communities and solve malnutrition issues faced by our State and Nation leading to a new green revolution catering to the development needs of our farming communities.

Keywords: Native Basmati Variety, Annamalai University Integrated Farming System, Extension Posters, New Green Revolution

INTRODUCTION

Veera Narayana Agricultural Farmer Producer Company Limited was started with the participation of about 1006 farmers each contributing Rs.1000 and was registered under companies act. The share capital generated from the farmers to a tune of 10 lakhs and 6 thousand was used in its inception and development of the company to undertake various constructive activities benefiting the farming communities of cuddalore and nearby cavery delta region. Veera narayana agricultural farmer producer company working in close co- ordination with the State Agricultural Marketing and Agricultural Commerce department is a pioneer in establishing a seed processing cum processing centre in cuddalore district. Starting its service from 24.01.2017 under the leadership Thiru.R. Natrajan

Pillai, it was started with the contribution of about fifty Farmer Interest Groups (FIGs) functioning at village level with each group comprising twenty members. This FIGs functioning in five block of cuddalore district namely Kumaratchi, Kattumannarkoil, Parangipettai, Keerapalyam and Buvanagiri started savings bank account and deposited Rs. 1000 per head. Through this deposited money as seed money, it started its functioning with a team of elected board members. It has purchased land through kisan mitra producer loan from Indian bank to a tune of Rs.60 lakhs sanctioned for carrying out its development activities and initiatives. This company services its diverse stakeholders by providing quality seeds at affordable price so that the cost of production or cultivation is kept low benefiting the farming community. Further through the supply of quality farm inputs, This company has also assisted the farmers to achieve higher production and productivity.

It has acquired seed license, pesticide license, fertilizer license and seed processing unit license over a period of time for carrying out its seeds, fertilizer, pesticides and herbicides business. The company is also in the sale of plant protection equipments benefitting the small and marginal farmers through this service. With seed production and distribution being its major business activity, off late it is involved in the promotion of native folk varieties. Its seeds are sold under a brand name "Veeranam Seeds" highly popular among the cuddalore and cavery district farmers. With about 50 lakh acre under paddy cultivation in Tamil Nadu and with Tanjore, Villupuram, Thiruvarur, Nagapattinam, Cuddalore and Kanchipuram contribution a major share in paddy cultivation, there is a dire need of quality paddy seeds of about 1 lakh tones. At present the State Department of Agriculture is able to supply only 50000 tonnes of quality seeds to meet this seed demand. So to reduce the deficiency in seed production, the veera narayanan agricultural farmer producer company is actively working to increase its seed production and distribution business. Though a select board of directors run the company activities, the day today operations are done through chief executive officer who is a farm graduate. Besides this routine activities, the company had established tie up with few farm equipment manufacturers and offer free service like tilling land benefitting its small and marginal farmers.

New Farm Extension Initiatives and on farm research Interventions with Annamalai University:

Being led by innovative and elite farmers, the Veera Narayana Farmer Producer Company is actively involved with the village extension work of Annamalai University off late with farmers in cuddalore and cavery districts slowly moving towards cultivation of traditional folk or native varieties, this Veera Narayana Agricultural Farmer Producer Company under the dynamic leadership of its chairman Thiru.R. Natrajan Pillai and board of directors have been successful in cultivating native varieties following organic agricultural practices. At present they are actively involved in the cultivation of native country basmati rice which has huge market potential. Being a local native variety, it is resistant to many pest and disease problems. The farmers raising it by following organic farm practices are able to bring down the cost of production and realize more profits from this farm produce. This local basmati variety gaining more acceptance for it taste and nutritional content is purchased by local grain traders and middle man directly in farmer fields by offering remunerative prices. With yield being comparable to the earlier cultivating varieties like NLR, BPT5204, Trichy 3, TKM 13, the farmer can gain more profits through sales of its seeds and by its value adding it. A on farm demonstration farm named after popular farm leader of Tamil Nadu namely Thiru. G. Nammavalar on Native Basmati cultivation in 1.66 acre at pinnalur was inaugurated by Dr.RM. Kathiresan, Vice Chancellor of Annamalai University.

This extension initiative was organized by Farmer's Agricultural Technology Information Centre and Centre for Rural Development, Annamalai University in Veera Narayana Agricultural Farmer Producer Company. This attracted lot of media attention with more press publications in regional dailies like Daily Thanthi, Dinamani, Theekkathir, The Hindu (Tamil), Farm magazines like Kumudam Manvasani, Farm broadcast in Makkal Television, Velicham Tv and State run 'Pothigai Tv' channels highlighting this new extension and farm research activities. This generated huge interest among the farming communities from across the world to cultivate native basmati traditional folk variety following organic farm practices. A new Extension poster on "Annamalai University Integrated Farming System" developed by Prof. Dr. R.M. kathiresan and his team members was also designed and released in the farmer interaction event to popularize and solve the present day malnutrition issues affecting Tamil

Nadu and our Nation. At present Participatory Research and Extension Trials (PRET) on Integrating country Basmati variety with Annamalai University " Integrated Farming System Model" is to be undertaken in farmer fields to improve the production, productivity, profitability of paddy cultivation in cuddalore district and also in the nearby disadvantaged districts.

International Farm Research Partnerships for a New Green Revolution

The Faculty of Agriculture, Annamalai University has been in partnership with many national funding agencies like Department of Science and Technology, GOI, Indian Council of Agricultural Research (ICAR), NABARD, Tamil Nadu State Planning Commission, Indian Council of Social Science Research (ICSSR), National Agriculture and Food Research Organization (NARO) Association of Indian Universities and International funding agencies like Bill & Melinda Gates foundation, USAID, The world Bank, SAARC,FAO, Institute of Plant Protection, Chinese Academy of Agricultural Sciences, Dalhousie University, Cornell University, East University, (Srilanka) for the past many decades. An Academic, Research and Extension partnership with International Rice Research Institute (IRRI), Philippines spanning over a decade has resulted in the successful demonstration of many new Annamalai University farm interventions which are climate resistant and protecting the livelihoods needs of small and marginal farmers across our nation and also in SAARC countries. Being climate smart farm technologies, they are able to with stand the vagaries of monsoon and improve farm production and productivity. With our present central and state governments initiating farm efforts to double farm incomes, Annamalai University through its new farm interventions developed, designed and executed through the on farm participatory research and extension trials by Prof. Dr. R.M. kathiresan and his team members are able to triple farmers income and also ensure nutritional security to small and marginal farmers of our state, nation and across the geographies throughout the world.

In the recently organized Research and Academic Partnership meeting with IRRI, the seed grains of Native Basmati variety was handed over by the chairman and board members of veera narayana farmer producer organization to Prof. Dr. R.M. Kathiresan who in turn handed over it to the visiting IARI research team of Dr.Ajay Kozhli and South Asia Advisor Dr. Umesh Sankar Singh. The main objective of this research and extension initiative is to find out the nutritional content, ie Glycemic Index (a relative ranking of carbohydrate in foods according to how they affect blood glucose levels) and also explore its cultivation with low cost effective parameters suited to the development needs of our farming communities. Through this new academic, research and extension partnership initiatives in farmers fields, Annamalai University is initiating a new farm revolution thereby ensuring development of new climate resilient farm varieties giving more profits to our farming community and also assist us in solving the malnutrition problems faced by our state and nation. In years to come with the climate change issues gaining more focus and priority in our farm research, the need of the hour is also to develop new farm development models catering to the needs of all stakeholders in our farming systems.

CONCLUSION

The Veera Narayana Agricultural Farmer Producer Company in association with Farmer's Agricultural Technology Information Cell (FATIC) through Participatory Research and Extension Initiatives of Annamalai University is going to solve many of our farm related climate change issues, Price fluctuations in farm markets affecting our farming communities and malnutrition issues faced by our nation. At present being mentored and guided with international team of experts in all their farm initiatives, the day is not far for our farmers to realize more profits through sustainable farm production by integrating traditional folk varieties with Annamalai University Integrated Farming System (IFS) model. Our Policy Planners, Farm Scientists, Extension workers and Mass Media need to integrate and work together in developing a new climate resilient farming model integrating more farm components in raising our farmer's income in the near future.

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Fig. 1: Veera Narayana Agricultural Farmer Producer Company Ltd in Pinnalur, Tamil Nadu

Fig. 2: Inauguration of Thiru. G. Nammavalvar on farm demonstration farm by Dr. RM. Kathiresan, Vice Chancellor, Annamalai University

Fig. 3: Release of Extension Poster on Annamalai University Integrated Farming System for solving malnutrition issues of our nation

Fig. 4: Thiru. R.Natrajan Pillai, Chairman, Veera Narayana Agricultural Farmer Producer Company Ltd Handing over Native Basmati Seeds to Dr. RM. Kathiresan, Vice Chancellor, Annamalai University for Future Agricultural Research on Climate Resilient farm varieties

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RESEARCH ARTICLE

η-Anti Q-Fuzzy Subring

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ABSTRACT

In this paper, we outline the$\eta - anti\ Q$ fuzzy subring (QFSR) and mentioned numerous essential elements of$\eta - anti\ Q$FSR. We present the possibility of the Q-subset of Fuzzy Set(FS) and show that Q-subset of a $\eta - anti\ Q$FSR form a ring. We outline $\eta - anti\ Q$ Fuzzy Ideal and prove that set of all$\eta - anti\ Q$ fuzzy coset structure a ring. Moreover, we explore the properties of Homomorphic image(Hom_img) of $\eta - anti\ Q$FSR.

Keywords: Q-Fuzzy subring (Q-FSR), $\eta - anti\ Q$-Fuzzyset ($\eta - AQFS$),$\eta - anti\ Q$ −Fuzzy subring ($\eta - AQ$FR),$\eta - anti\ Q$ −Fuzzy Ideal($\eta - AQ$ FI), $\eta - anti\ Q$ −Fuzzy coset ($\eta - AQFC$)

INTRODUCTION

The development of the Fuzzy set was presented by zadeh[1]. The thought of intuitionistic Fuzzy set presented by astanassov [11] generalization of the idea of a Fuzzy set. Solairaju & Nagarajan[3] investigated a modern structure and development of -Q Fuzzygroup in 2009 and Biswas [9] presented the idea of Anti Fuzzy Subgroup and built up a few essential futures of phenomenon. Rausli[10] examined Q -fuzzy subring with regard to t-norm in 2018 and UmerShuaib [5] discussedinη −Anti Fuzzy Subgroups. Amid this paper, we have an inclination to tend to present the development of$\eta - anti\ Q$ Fuzzy Subring and $\eta - anti\ Q$ Fuzzy Ideal and created a few results.

PRELIMINARIES

Definition 2.1 [1] Let$X \neq \emptyset$. A maps X to [0,1]is consider as fuzzy subset(FS) of X.

Definition 2.2. [5] A functions: [0,1] × [0,1] → [0,1] is supposed to be a ŧ-conorm iff ŝ admits following properties $\forall a, b, c, d\ in$ [0,1]

i. $s(a,b) = s(b,a)$
ii. $s(a, s(b,c)) = s(s(a,b),c)$
iii. $s(a,0) = s(0,a) = a$
iv. if $a \le c$ and $b \le d$ then $s(a,b) \le s(c,d)$

Definition 2.3 [3] Let$X$ and $Q \neq \emptyset$. A function$A$ maps $X \times Q$ *to* [0,1]is defined as$Q$FS A of X.

Definition 2.4 [3] For a ring $(R,+,\cdot)$ & $Q \neq \emptyset$, the Q-FS A of R, Q-FSR of R If $\forall x, y, \in R$ &$q \in Q$
i. $A(x+y,q) \geq \min (A(x,q), A(y,q)$
ii. $A(xy,q) \geq \min (A(x,q), A(y,q))$
iii. $A(-x,q) \geq A(x,q)$

Definition 2.5 [4] Let$R$ be a ring & $Q \neq \emptyset$. If $\forall x, y, \in R$, and $q \in Q$
(i).$A(x+y,q) \leq \max (A(x,q), A(y,q)$
(ii).$A(xy,q) \leq \max (A(x,q), A(y,q))$
(iii). $A(-x,q) \leq A(x,q)$then Q-FS $A$of ring R, is called AQFSRof R.

Definition 2.6 [5] Let $s_b : [0,1] \times [0,1] \to [0,1]$ bounded sum conorm defined by
$s_b(x,y) = \min(x+y, 1), 0 \le x \le 1, 0 \le y \le 1$, Obviously, limited conorm fulfill all the axioms t-conorm.The basic t-conorm are $s_m(x,,y) = V\{x, y\}$ and
$s_p(x,y) = x + y - xy \; \forall \; x, y \in [0,1]$ $s_m$is standard norm,s_p is algebraic sum review that t-conorm s is idempotent if $\forall x \in [0,1]$, $s(x,x) = x$.

PROPERTIES OF $\eta - ANTIQ$ FUZZY SUBRING

Definition 3.1 Let$A$be a FS of a set $X$and $\eta \in [0,1]$, the FS A^η of $X$is called the$\eta - AQ$FS of X(wrto fuzzy set A) and characterized as $A^\eta(\boldsymbol{x}, q) = s_b(A(\boldsymbol{x}, q), 1-\eta) \;\; \forall \; \boldsymbol{x} \in X$

Definition 3.2 Let $(R,+,\cdot)$be a ring and $Q \neq \emptyset$. AQFS $A^\eta$of$R$ is said to be an $\eta - AQ$FSR w.r.to t-conorm s assuming the conditions are fulfilled
i.$A^\eta(x+y,q) \leq \max (A(x,q), A(y,q)$. ii.$A^\eta (xy,q) \leq \max (A^\eta (x,q), A^\eta(y,q))$ iii. $A^\eta(-x,q) \leq A^\eta(x,q)$

Remark 3.3 Clearly $A^1(x,q) = 0$ and $A^0(x,q) = A(x,q)$.

Remark 3.4 If Aand B be two $AQFS$ of X , then $(A \cup B)^\eta = A^\eta \cup B^\eta$.

Proposition 3.5 Let R be ring to be any non null set and A be a QFSof R, and $\eta \in [0,1]$. Then the FSA$^\eta$is$\eta - AQ$FSR iff
(i)$A^\eta (x-y,q) \leq \max \{A^\eta (x,q), A^\eta(y,q)\}$ (ii)$A^\eta (xy,q) \leq \max (A^\eta(x,q), A^\eta(y,q))$

Proof: It is straight forward and omitted.

Proposition 3.6 (i) Let A^η *be* AQFSR and S be a idempotent then $\forall \boldsymbol{x} \in X$ and $q \in Q$,$A^\eta(0,q) \leq A^\eta(\boldsymbol{x},q)$(ii) if$A^\eta(\boldsymbol{x} - y, q = A\eta 0, q \Rightarrow A\eta \boldsymbol{x}, q = A\eta y, q$

Proof (i)Let$A^\eta(0,q) = A^\eta((x-x),q) \leq V\{A^\eta(x,q), A^\eta(x,q)\} \leq A^\eta(x,q) \forall x \in R$
(ii)$A^\eta(x,q) = A^\eta(x-y+y,q) \leq V\{A^\eta(x-y,q), A^\eta(y,q)\} = V\{A^\eta(0,q), A^\eta(y,q)\} = A^\eta(y,q)$Similarly $A^\eta(y,q) \leq A^\eta(x,q)$. This implied that $A^\eta(x,q) = A^\eta(y,q) \forall \; x, y, \in R$, and $q \in Q$■

Proposition 3.7 IfA is AQFSR of a ring R then A is a $\eta - AQ$FSR

Proof Assume that μ is a AQFSR of a ring R and $x, y, \in R \& q \in Q$
Let $\mu^{\eta}(x-y,q) = s_b(\mu(x-y,q),1-\eta) \leq s_b \{\max(\mu(x,q),\mu(y,q)),1-\eta)\}$
$\leq s_b\{\max(\mu(x,q),1-\eta),(\mu(y,q),1-\eta)\} \leq max \{s_b(\mu(x,q),1-\eta),s_b(\mu(y,q),1-\eta)\}$
$\Rightarrow \mu^{\eta}(x-y,q) \leq \max(\mu^{\eta}(x,q),\mu^{\eta}(y,q))$
Further $\mu^{\eta}(xy,q) = s_b(\mu(xy,q),1-\eta) \leq s_b \{\max(\mu(x,q),\mu(y,q)),1-\eta)$
$\leq s_b \{\max(\mu(x,q),1-\eta),(\mu(y,q),1-\eta)\} \leq \max\{s_b(\mu(x,q),1-\eta),s_b(\mu(y,q),1-\eta)\}$
$\Rightarrow \mu^{\eta}(xy,q) \leq max(\mu^{\eta}(x,q),\mu^{\eta}(y,q))$
Inevitably, μ is an $\eta - AQ$FSR of R, overall the opposite may not be valid ■

Example 3.8 Consider the ring $R = (Z_4, +, \cdot)$ where $Z_4 = \{0,1,2,3\}$ and let $Q = \{q\}$, let the $QFS\mu$ be Characterized by $\mu(0,q) = 0.49, \mu(1,q) = \mu(3,q) = 0.51, \mu(2,q) = 0.57$ by $\eta - AQ$FSR take $\eta = 0.05$ then $\mu^{\eta}(x,q) = s_b(\mu(x,q),1-\eta) =$ min $\{\mu(x,q)+1-\eta,1\} \Rightarrow \mu^{\eta}(x-y,q) \leq max(\mu^{\eta}(x,q),\mu^{\eta}(y,q))$ further,we have $\mu^{\eta}(xy,q) \leq V(\mu^{\eta}(x,q),\mu^{\eta}(y,q))$, But since $\mu(3-1,q) = \mu(2,q) = 0.57 \not\leq \max(\mu(3,q),\mu(1,q)) = 0.51$
Inevitable $y\mu$ is $\eta - AQ$FSR of R and μ is not AQFSR of R.

Definition 3.9 Let μ be a FS of a universe X and $\delta \in [0,1]$ then $\mu_{\delta}^{\eta} = \{x \in X : \mu(x,q) \leq \delta\}$ is
Defined as level subset of a Q FS μ

Theorem 3.10 Let μ be $\eta - AQ$FSR of R then μ_{δ}^{η} is a subring of R for all $\mu^{\eta}(0,q) \leq \delta$

Proof Let $x, y, \in R$, then μ be a $\eta - AQ$FSR of a ring R. Clearly μ^{η} is nonempty, since μ is an $\eta - AQ$FSR
$\Rightarrow \mu^{\eta}(x,q) \geq \mu^{\eta}(0,q) \forall x \in R \& q \in Q$. allow $x, y, \in \mu_{\delta}^{\eta}$ then $\mu^{\eta}(x,q) \leq \delta$ and $\mu^{\eta}(y,q) \leq \delta$
now (i) $\mu^{\eta}(x-y,q) \leq \max(\mu^{\eta}(x,q),\mu^{\eta}(y,q) \leq \max\{\delta,\delta\} \Rightarrow \mu^{\eta}(x-y,q) \leq \delta$
(ii) $\mu^{\eta}(xy,q) \leq max(\mu^{\eta}(x,q),\mu^{\eta}(y,q) \leq \max\{\delta,\delta\} \Rightarrow \mu^{\eta}(xy,q) \leq \delta \Rightarrow x-y, xy \in \mu_{\delta}^{\eta}$. Hence μ_{δ}^{η} is a Subring of R

Definition 3.11 Let μ be AQFSR of a ring $\boldsymbol{R}$ and $\eta \in [0,1]$ then μ^{η} is $\eta - AQ$FLI
i. $\mu^{\eta}(x-y,q) \leq max(\mu^{\eta}(x,q),\mu^{\eta}(y,q))$ ii. $\mu^{\eta}(xy,q) \leq \mu^{\eta}(y,q) \forall x, y \in \boldsymbol{R}$ and $q \in Q$

Definition 3.12 Let μ be AQFSR of a ring $\boldsymbol{R}$ and $\eta \in [0,1]$ then μ^{η} is $\eta - AQ$FRI
i. $\mu^{\eta}(x-y,q) \leq max(\mu^{\eta}(x,q),\mu^{\eta}(y,q))$ ii. $\mu^{\eta}(xy,q) \leq \mu^{\eta}(x,q) \forall x, y, \in \boldsymbol{R}$ and $q \in Q$

Definition 3.13 Let μ be AQFSR of ring $\boldsymbol{R}$ and $\eta \in [0,1]$ then μ^{η} is $\eta - AQ$ FI of R if
i. $\mu^{\eta}(x-y,q) \leq \max(\mu^{\eta}(x,q),\mu^{\eta}(y,q))$ ii. $\mu^{\eta}(xy,q) \leq \min(\mu^{\eta}(x,q),\mu^{\eta}(y,q)) \forall x, y, \in \boldsymbol{R}$ and $q \in Q$

Theorem 3.14 Let μ be $\eta - AQ$FI of $\boldsymbol{R}$ then the set $\mu_o^{\eta} = \{x \in R : \mu^{\eta}(x,q) = \mu^{\eta}(0,q)\}$ is ideal of ring $\boldsymbol{R}$

Proof: Clearly $\mu_o^{\eta} \neq \emptyset$ because $0 \in R$ let $x, y, \in \mu_o^{\eta}$ be any elements. Then $\mu^{\eta}(x,q) = \mu^{\eta}(0,q)$ and $\mu^{\eta}(y,q) = \mu^{\eta}(0,q)$.
Consider, $\mu^{\eta}(x-y,q) \leq \max(\mu^{\eta}(x,q),\mu^{\eta}(y,q)) \leq \max(\mu^{\eta}(0,q),\mu^{\eta}(0,q))$
$\Rightarrow \mu^{\eta}(x-y,q) \leq \mu^{\eta}(0,q)$. But $\mu^{\eta}(0,q) \leq \mu^{\eta}(x-y,q)$. Therefore $\mu^{\eta}(x-y,q) = \mu^{\eta}(0,q) \Rightarrow x-y \in \mu_o^{\eta}$ Further ,$\mu^{\eta}(xy,q) \leq \min(\mu^{\eta}(x,q),\mu^{\eta}(y,q) \leq \min(\mu^{\eta}(0,q),\mu^{\eta}(0,q)) = \mu^{\eta}(0,q)$
But $\mu^{\eta}(0,q) \leq \mu^{\eta}(xy,q)$. Therefore $\mu^{\eta}(xy,q) = \mu^{\eta}(0,q)$ Similarly $\mu^{\eta}(yx,q) = \mu^{\eta}(0,q)$, $xy, yx \in \mu_o^{\eta}$
μ_o^{η} is an ideal ■

Definition 3.15 Let μ be a $\mu^{\eta} - AQFSR$ of a ring R and $\eta \in [0,1]$ for any $\hbar \in R$ and $q \in Q$ the
$\mu^{\eta} - AQF$ of coset($\mu^{\eta} - AQFC$) μ in R is represented by $X + \eta$ defined as
$(x + \mu^{\eta})(\hbar, q) = S_b\{\mu(\hbar - x, q), 1-\delta\} = \mu^{\eta}((\hbar - x), q)$ for all $\hbar, \omega \in R$ and $q \in Q$.

Theorem 3.16 Let μ^{η} be a $\eta - AQFI$ of a ring R, $x, y, \in R$ and $q \in Q$, then $(x + \mu^{\eta}) = (y + \mu^{\eta})$ iff $x - y \in \mu_o^{\eta}$

Proof $\forall x, y \in \dot{R}$ we have $(x + \mu^{\eta}) = (y + \mu^{\eta})$
Consider $\mu^{\eta}(x - y, q) = (y + \mu^{\eta})(x, q) = (x + \mu^{\eta})(x, q) = \mu^{\eta}(0, q)$ therefore $x - y \in \mu_o^{\eta}$ Conversely, let $x - y \in \mu_o^{\eta}$ implies that $\mu^{\eta}(x - y, q) = \mu^{\eta}(0, q)$
Consider $(x + \mu^{\eta})(\hbar, q) = \mu^{\eta}((\hbar - x), q) = \mu^{\eta}((\hbar - y) - (x - y), q) \leq max\ (\mu^{\eta}(\hbar - y, q), \mu^{\eta}(x - y, q)) = max\ (\mu^{\eta}(\hbar - y, q), \mu^{\eta}(0, q)) = \mu^{\eta}((\hbar - y), q) = (y + \mu^{\eta})(\hbar, q)$
Therefore $(x + \mu^{\eta})(\hbar, q) = (y + \mu^{\eta})(\hbar, q) \forall\ \hbar \in \dot{R}$■

Definition 3.17 Let μ be a $\eta-AQFI$ of a ring R the set of all $\mu^{\eta}-AQFC$ of μsignified by $R/_{\mu^{\eta}}$ structure a ring w.r.to binary operation $*$characterized by
$((x, q) + \mu^{\eta}) + ((y, q) + \mu^{\eta}) = (x + y, q) + \mu^{\eta}$ where
$x + \mu^{\eta}, y + \mu^{\eta} \in R/_{\mu^{\eta}}.((x, q) + \mu^{\eta}) * (y, q + \mu^{\eta}) = (x * y, q) + \mu^{\eta}$ where $x + \mu^{\eta}, y + \mu^{\eta} \in R/_{\mu^{\eta}}, x, y, \in R$the ring $R/_{\mu^{\eta}}$ is known as the factor ring of R w.r.toc $-AQ$FI.

Theorem 3.18 The set $R/_{\mu^{\eta}}$ structures a ring w.r.to the above expressed binary operation.

Proof: Let $(x_1 + \mu^{\eta}) = (x_2 + \mu^{\eta})$ and$(y_1 + \mu^{\eta}) = (y_2 + \mu^{\eta})$for some $x_1 x_2, y_1, y_2 \in \dot{R}$. Letg $\in \dot{R}$ be any
Element of $\dot{R}$and $q \in Q$, $(x_2 + y_2 + \mu^{\eta})(g, q) = \mu^{\eta}(g - (x_2 + y_2), q)$
$= \mu^{\eta}((g - x_2 - y_2), q)$,$= y_2 + \mu^{\eta}((g - x_2), q)$, $= y_1 + \mu^{\eta}((g - x_2), q)$
$= \mu^{\eta}((g - x_2 - y_1), q)$,$= x_2 + \mu^{\eta}((g - y_1), q)$, $= x_1 + \mu^{\eta}((g - y_1), q)$
$= \mu^{\eta}\left((g - x_1 - y_1), q\right)$,$= \mu^{\eta}\left((g - (x_1 + y_1), q\right)$,$= (x_1 + y_1 + \mu^{\eta})(g, q)$Moreover$(x_2 y_2 + \mu^{\eta})(g, q) = \mu^{\eta}(g - x_1 y_1 - (x_2 y_2 - x_1 y_1), q) \leq \max\ \{\mu^{\eta}(g - x_1 y_1), \mu^{\eta}\left((x_2 y_2 - x_1 y_1), q\right)\}$
But we have $\mu^{\eta}\left((x_2 y_2 - x_1 y_1), q\right) = \mu^{\eta}\left((x_1 y_1 - x_2 y_1 + x_2 y_1 - x_2 y_2), q\right) = \mu^{\eta}((x_1 - x_2) y_1 + x_2 (y_2 - y_1), q \leq max\{\mu^{\eta}\left((x_1 - x_2) y_1, q\right),$
$\mu^{\eta}(x_2 (y_1 - y_2), q)\}$,$= \max\ \{\mu^{\eta}\left((x_1 - x_2), q\right), \mu^{\eta}(y_1 - y_2), q)\}$, $= \max\ \{\mu^{\eta}(0, q), \mu^{\eta}(0, q)\}$
$\mu^{\eta}\left((x_2 y_2 - x_1 y_1), q\right) \leq \mu^{\eta}(0, q)$, $(x_2 y_2 + \mu^{\eta})(g, q) \leq \mu^{\eta}\left((g - x_1 y_1), q\right) = (x_1 y_1 + \mu^{\eta})(g, q)$
Similarly, we can prove that $(x_2 y_2 + \mu^{\eta})(g, q) \geq (x_1 y_1 + \mu^{\eta})(g, q)$,
Inevitably $(x_2 y_2 + \mu^{\eta})(g, q) = (x_1 y_1 + \mu^{\eta})(g, q)$, in this manner$*$ is welldefined. now we can exhibit that the following aphorisms of ring,$\forall\ x, y, \in \dot{R}$.
1.$(x + \mu^{\eta}) + (y + \mu^{\eta}) = x + y + \mu^{\eta}$ 2.$(x + \mu^{\eta}) + [(y + \mu^{\eta}) + (z + \mu^{\eta})] = x + \mu^{\eta} + [y + z + \mu^{\eta}] = [[x + y] + z] + \mu^{\eta} = [x + y + \mu^{\eta}] + z + \mu^{\eta} = [(x + \mu^{\eta}) + (y + \mu^{\eta})] + (z + \mu^{\eta})$3.$(X + \mu^{\eta}) + (y + \mu^{\eta}) = x + y + \mu^{\eta} = y + x + \mu^{\eta} = (y + \mu^{\eta}) + (x + \mu^{\eta})$4.$(0 + \mu^{\eta}) + (y + \mu^{\eta}) = y + \mu^{\eta}$5.$(X + \mu^{\eta}) + (-x + \mu^{\eta}) = \mu^{\eta}$6.$(X + \mu^{\eta}) + (y + \mu^{\eta}) = xy + \mu^{\eta}$7.$(x + \mu^{\eta})[(y + \mu^{\eta})(z + \mu^{\eta})] = x + \mu^{\eta} + [yz + \mu^{\eta}] = xyz + \mu^{\eta} = [xy + \mu^{\eta}] + z + \mu^{\eta} = [(x + \mu^{\eta})(y + \mu^{\eta})](z + \mu\eta$
8.$(X + \mu^{\eta})[(y + \mu^{\eta})(z + \mu^{\eta})] = (x + \mu^{\eta})((y + z) + \mu^{\eta}) = x(y + z) + \mu^{\eta} = (xy + \mu^{\eta}) + (xz + \mu^{\eta}) = [(x + \mu^{\eta})(y + \mu^{\eta}) + (x + \mu^{\eta})(z + \mu^{\eta})]$
9.$[(Y + \mu^{\eta})(z + \mu^{\eta})](x + \mu^{\eta}) = ((y + z) + \mu^{\eta})(x + \mu^{\eta}) = (y + z)x + \mu^{\eta} = (yx + zx) + \mu^{\eta} = (yx + \mu^{\eta}) + (zx + \mu^{\eta}) = [(y + \mu^{\eta})(x + \mu^{\eta}) + (z + \mu^{\eta})(x + \mu^{\eta})]$ inevitably, $(\dot{R}/_{\mu^{\eta}}, +, *)$ is ring■

HOMOMORPHISM OF $\eta - ANTIQ$ FUZZY SUBRING

Definition 4.1 Let the mapping $f: \dot{R}_1 \to \dot{R}_2$ be a homomorphism (Homm). Let $\acute{M}$ and $\acute{N}$ be $\eta - AQFSR$ of $\dot{R}_1$ and $\dot{R}_2$ respectively Then $f(\acute{M})$ and $f^{-1}(\acute{N})$are image(img) and inverse image(inv_im) of $\acute{N}$ separately.
characterized as

(i) $f(\acute{M})(y,q) = \begin{cases} \sup\{A(x,q): x \in f^{-1}(y), \text{if } f^{-1}(y) \neq \emptyset \\ 0, \text{if } f^{-1}(y) = \emptyset \end{cases}$ for every $y \in R_2$ and $q \in Q$

(ii) $f^{-1}(\acute{N})(x,q) = \acute{N}(f(x),q)$ for every $x \in R_1$ and $q \in Q$

Lemma 4.2 Let $f: x \to y$ be a mapping and Ḿ&Ń be two FS of R_1 and R_2respectively, then

(i) $f^{-1}\left(\acute{N}^{\eta}\right)(x,q) = \left(f^{-1}(\acute{N})\right)^{\eta}(x,q) \forall X \in R_1$and $q \in Q$

(ii) $f(\acute{M}^{\eta})(y,q) = (f(\acute{M}))^{\eta}(y,q) \forall Y \in R_2$and $q \in Q$

Proof (i) $f^{-1}\left(\acute{N}^{\eta}\right)(x,q) = \acute{N}^{\eta}(f(x,q)) = S_b\{\acute{N}(f(x,q)), 1-\eta\} = S_b\left\{\left(f^{-1}(\acute{N})(x,q)\right), 1-\eta\right\}$

$f^{-1}\left(\acute{N}^{\eta}\right)(x,q) = \left(f^{-1}(\acute{N})\right)^{\eta}(x,q) \forall x \in X(ii)f(\acute{M}^{\eta})(y,q) = sup\{\acute{M}^{\eta}(x,q): f(x) = y\} =$

$\sup\{S_b(\acute{M}(x,q), 1-\eta): f(x) = y\} = S_b\{\sup\{(\acute{M}(x,q): f(x) = y), 1-\eta\}\} = S_b\{f(\acute{M})(y,q), 1-\eta\}$

$= (f(\acute{M}))^{\eta}(y,q) \forall Y \in y$Hence $f(\acute{M}^{\eta})(y,q) = (f(\acute{M}))^{\eta}(y,q)$ ■

Theorem 4.3 Let $f: R_1 \to R_2$be homm from a ring $R_1$to a ring R_2 and A be an $\eta - AQFSR$ of R_1then $f(A)$ is a $\eta - AQFSR$ of R_2

Proof let$A$ be a $\eta - AQFSR$ of R_1. Let $y_1, y_2 \in R_2$be any element $\exists$uniqueelement$x_1, x_2 \in R_1 \ni f(x_1) = y_2 \& f(x_2) =$ $y_1$and $q \in Q$. Consider $(f(A))^{\eta}((y_1 - y_2), q) = S_b\{(f(A)(y_1 - y_2), q), 1-\eta\} = S_b\{f(A)(f(x_1) - f(x_2), q), 1-\eta\}$

$= S_b\{f(A)(f(x_1 - x_2), q), 1-\eta\} = S_b\{(A((x_1 - x_2), q), 1-\eta\} = A^{\eta}((x_1 - x_2), q)$

$\leq \max\{A^{\eta}(x_1, q), A^{\eta}(x_2, q)\} \forall x_1, x_2 \in R_1$ suchthat $f(x_1) = y_1, f(x_2) = y_2$ }

$\leq \max\{sup\{A^{\eta}(x_1, q): f(x_1) = y_1\}, sup\{A^{\eta}(x_2, q): f(x_2) = y_2\}\} = \max\{f(A^{\eta})(y_1, q), f(A^{\eta})(y_2, q)\}$

$= \max\{(f(A))^{\eta}(y_1, q), (f(A))^{\eta}(y_2, q)\}$

$\Rightarrow (f(A))^{\eta}((y_1 - y_2), q) \leq \max\{(f(A))^{\eta}(y_1, q), (f(A))^{\eta}(y_2, q)\}$

Further $(f(A))^{\eta}((y_1 y_2), q) = S_b\{(f(A)(y_1 y_2), q), 1-\eta\} = S_b\{f(A)(f(x_1)f(x_2), q), 1-\eta\}$

$= S_b\{f(A)(f(x_1 x_2), q), 1-\eta\} = S_b\{(A((x_1 x_2), q), 1-\eta\} = A^{\eta}((x_1 x_2), q)$

$\leq \max\{A^{\eta}(x_1, q), A^{\eta}(x_2, q)\} \forall x_1, x_2 \in R_1$ suchthat $f(x_1) = y_1, f(x_2) = y_2$ }

$\leq \max\{sup\{A^{\eta}(x_1, q): f(x_1) = y_1\}, sup\{A^{\eta}(x_2, q): f(x_2) = y_2\}\}$

$= \max\{f(A^{\eta})(y_1, q), f(A^{\eta})(y_2, q)\} = \max\{(f(A))^{\eta}(y_1, q), (f(A))^{\eta}(y_2, q)\}$

$\Rightarrow (f(A))^{\eta}((y_1 y_2), q) \leq \max\{(f(A))^{\eta}(y_1, q), (f(A))^{\eta}(y_2, q)\}$

Inevitably, $f(A)$ is a $\eta - antiQFSR$ of ring R_2 ■

Theorem 4.4 Let $f: R_1 \to R_2$ be a homm from a ring R_1toR_2 and Ń be a $A^{\eta} - AQFSR$ of R_2 And $f^{-1}(\acute{N})$is $\eta - AQFSR$ of R_1

Proof Let Ń be a $\eta - AQFSR$ of $R_2$and let $x_1 x_2, \in R_1$be any element then,

$\left(f^{-1}(\acute{N})\right)^{\eta}\left(\left(x_1 - x_2\right), q\right) = f^{-1}\left(\acute{N}^{\eta}\right)\left(\left(x_1 - x_2\right), q\right) = \acute{N}^{\eta}\left(f\left(x_1 - x_2\right), q\right)$

$= \acute{N}^{\eta}(f(x_1) - f(x_2), q) \leq \max\{\acute{N}^{\eta}(f(x_1), q), \acute{N}^{\eta}(f(x_2), q)\}$

$= \max\left\{f^{-1}\left(\acute{N}^{\eta}\right)(x_1, q), f^{-1}\left(\acute{N}^{\eta}\right)(x_2, q)\right\}$

Thus $\left(f^{-1}(\acute{N})\right)^{\eta}\left(\left(x_1 - x_2\right), q\right) \leq \max\left\{\left(f^{-1}(\acute{N})\right)^{\eta}(x_1, q), \left(f^{-1}(\acute{N})\right)^{\eta}(x_2, q)\right\}$

Further $\left(f^{-1}(\acute{N})\right)^{\eta}\left(\left(x_1 x_2\right), q\right) = f^{-1}\left(\acute{N}^{\eta}\right)\left(\left(x_1 x_2\right), q\right)$

$= \acute{N}^{\eta}\left(f\left(x_1 x_2\right), q\right) = \acute{N}^{\eta}(f(x_1)f(x_2), q) \leq \max\{\acute{N}^{\eta}(f(x_1), q), \acute{N}^{\eta}(f(x_2), q)\}$

$= \max\left\{f^{-1}\left(\acute{N}^{\eta}\right)(x_1, q), f^{-1}\left(\acute{N}^{\eta}\right)(x_2, q)\right\}$

Thus $\left(f^{-1}(\acute{N})\right)^{\eta}\left(\left(x_1 x_2\right), q\right) \leq \max\left\{\left(f^{-1}(\acute{N})\right)^{\eta}(x_1, q), \left(f^{-1}(\acute{N})\right)^{\eta}(x_2, q)\right\}$,inevitably, $f^{-1}(\acute{N})$ is $\eta - AQFSR$ of R_1 ■

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RESEARCH ARTICLE

An Innovative Parallel Cloud Storage System using Proxy Re Encryption

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ABSTRACT

High speed organizations and universal Internet access become accessible to clients for access anyplace whenever. Distributed computing is an idea that treats the assets on the Internet as a brought together element, a cloud. Distributed storage is a model of arranged internet-based capacity where information is put away in virtualized pools of capacity which are by and large facilitated by third gatherings. Facilitating organizations work enormous server farms, and individuals who require their information to be facilitated purchase or rent stockpiling limit from them. The server farm administrators, behind the scenes, virtualize the assets as per the prerequisites of the client and uncover them as capacity pools, which the clients could themselves at any point use to store records or information objects. Truly, the asset might traverse across different servers. Information heartiness is a significant prerequisite for stockpiling frameworks. There have been numerous recommendations of putting away information over capacity servers. One method for giving information power is to duplicate a message with the end goal that every capacity waiter stores a duplicate of the message. A decentralized deletion code is reasonable for use in a dispersed stockpiling framework. We build a solid distributed storage framework that upholds the capacity of secure information sending by utilizing an AES and Proxy re encryption. In this model introductory stage proprietor will transfer the information with AES Encryption. Next stage, within cloud again the information has isolated into little pieces, for this cycle we will apply a separating

key. Information will put in various capacity lactations. The data of information stockpiling will screen by a novel information merchant. Assuming that the legitimate client getting to the information cloud will recover the information as reversible way.

Key words: Distributed computing, Distributed storage**,** AES Encryption, capacity lactations.

INTRODUCTION

Fast associations and widespread Internet access become open to clients for access wherever at whatever point. Dispersed figuring is a thought that treats the resources on the Internet as a united component, a cloud. Dispersed capacity is a model of organized web-based amassing where data is taken care of in virtualized pools of limit which are overall worked with by third social occasions. Working with associations work tremendous server ranches, and people who require their data to be worked with buy or lease amassing limit from them. The server ranch executives, in the background, virtualize the resources as shown by the necessities of the client and uncover them as limit pools, which the clients would themselves have the option to use to store records or data objects. Really, the resource might go across various laborers. Data energy is a huge need for limit structures. There have been various suggestions of taking care of data over limit laborers. One way to deal with give data power is to reproduce a message so much that each limit labourer stores a copy of the message. A decentralized destruction code is sensible for use in a flowed amassing system. We assemble a safeguarded circulated capacity structure that maintains the limit of secure data sending by using an AES and Proxy re encryption. In this model early phase owner will move the data with AES Encryption. Next stage, inside cloud again the data has isolated into little pieces, for this cycle we will apply an apportioning key. Data will place in different limit lactations. The information of data accumulating will screen by a phenomenal data wholesaler. If the authentic client getting to the data cloud will recuperate the data as reversible way.

EXISTING SYSTEM

In Existing System, a clear reconciliation technique is utilized. In clear mix strategy Storing information in an outsider's cloud framework causes genuine worry on information privacy. To give solid classification to messages away servers, a client can scramble messages by a cryptographic strategy prior to applying an eradication code technique to encode and store messages. At the point when he needs to utilize a message, he wants to recover the Codeword images from capacity servers, disentangle them, and afterward decode them by utilizing cryptographic keys. General encryption plans safeguard information classification, yet additionally limit the usefulness of the stockpiling framework on the grounds that a couple of activities are upheld over scrambled information. A decentralized engineering for stockpiling frameworks offers great versatility, in light of the fact that a capacity server can join or leave without control of a focal power.

Disadvantages

- ✓ The client can perform more calculation and correspondence traffic between the client and capacity servers is high.
- ✓ The client needs to deal with his cryptographic keys in any case the security must be broken.
- ✓ The information putting away and recovering, it is difficult for stockpiling servers to help different capacities straightforwardly.

PROPOSED SYSTEM

In our proposed framework, we address the issue of sending information to one more client by capacity servers straightforwardly under the order of the information proprietor. We consider the framework model that comprises of conveyed stockpiling servers and key servers. Since putting away cryptographic keys in a solitary gadget is

unsafe, a client disperses his cryptographic key to key servers that will fill cryptographic roles in the interest of the client. These key servers are exceptionally safeguarded by security components. Here Storage framework has assigns by various information holder. When proprietor transfers the information with AES encryption instrument, framework again takes the information and makes Secure Data isolation process. Every one of the information pieces will be save in various area in distributed storage. Here open wholesaler screens every one of the information and it is saved to compare positions where it. At the point when a legitimate client asking the information, cloud framework will give the information in reversible way. So, our framework will keep our information from both Inside and Outside assailants.

Advantages of Proposed System

- ✓ Tight coordination of encoding, encryption, and sending makes the capacity framework productively meet the prerequisites of information strength, information secrecy, and information sending.
- ✓ The capacity servers freely perform encoding and re-encryption process and the key servers autonomously perform halfway decoding process.
- ✓ More adaptable change between the quantity of capacity waiters and power.

RELATED WORK

Registration

For the enrollment of client with character ID the gathering supervisor arbitrarily chooses a number. Then, at that point, the gathering chief adds into the gathering client list which will be utilized in the detectability stage. After the enlistment, client acquires confidential key which will be utilized for bunch signature age and record decoding.

Sharing Data

The standard application is information sharing. The public evaluating property is particularly helpful when we anticipate that the designation should be productive and adaptable. The plans empower a substance supplier to share her information in a secret land specific way, with a fixed and little ciphertext development, by conveying to each approved client a solitary and little total key.

Secure Cloud Storage

Data robustness is a huge essential for amassing structures. There has been various recommendation of taking care of data over limit servers. One technique for giving data power is to copy a message so much that each limit server stores a copy of the message. A decentralized annihilation code is fitting for use in a conveyed storing structure.

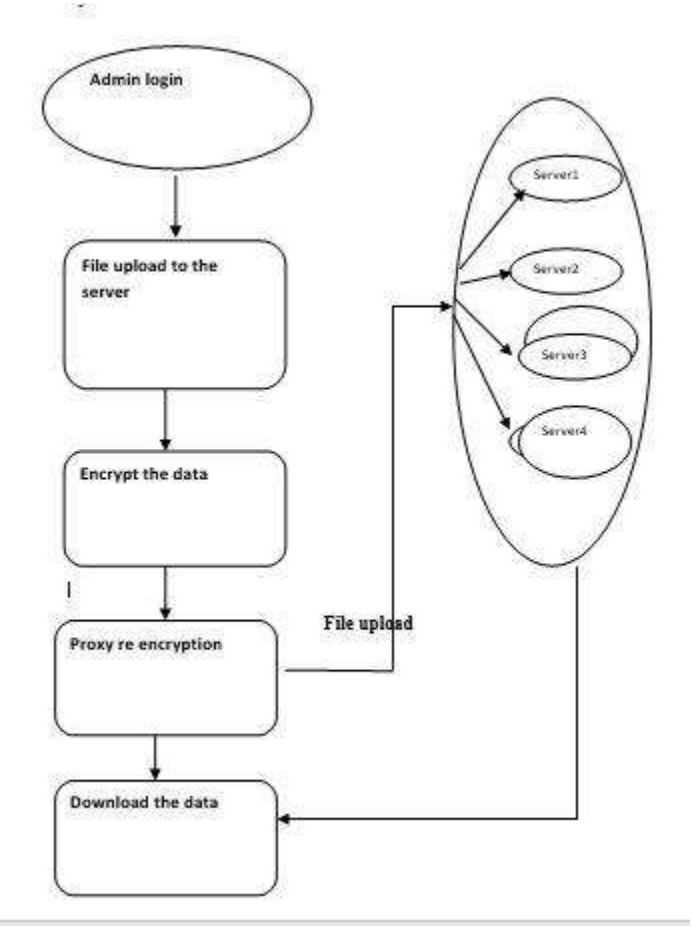
Proxy re-encryption

Proxy re-encryption plans are crypto frameworks which permit outsiders (proxies) to modify a code text which has been encoded for one client, with the goal that it very well might be unscrambled by another client. By utilizing intermediary re-encryption method, the scrambled information (figure text) in the cloud is again modified by the client. It gives exceptionally got data put away in the cloud. Each client will have a public key and confidential key. Public key of each and every client is known to everybody except private key is known just the specific client.

Data retrieval

Reports and information are the two essential types of the recovered information from servers. There are a few covers between them, however inquiries for the most part select a somewhat little piece of the server, while reports show bigger measures of information. Questions additionally present the information in a standard configuration and as a rule show it on the screen; though reports permit designing of the result anyway you like and is ordinarily recovered**.**

SYSTEM ARCHITECTURE



CONCLUSIONS

Erasure codes are promising for working on the dependability of the stockpiling framework because of its space productivity contrasted with the replication strategies. Conventional eradication codes split information into balanced information hinders and encode strips in various information blocks. This brings weighty fixing traffic when clients read pieces of the information, since most strips read for fixing are not in the normal squares. This paper proposes a clever discrete information separating strategy to stay away from this issue totally. The key thought is to encode takes from similar information block. We could see that for fixing bombed blocks, the strips to be perused are either in similar information block with defiled strips or from the encoded strips. Hence, no information is squandered. We plan and execute this information format into a HDFS-like capacity framework. Tests over a limited scale testbed shows that the proposed discrete information separated technique tries not to download information hinders that are not required for clients during the fixing tasks.

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