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RESEARCH ARTICLE

Application of Multi Influencing Factors for Delineation of Groundwater Potential Zonation Mapping of Vasishta Sub Basin in Tamil Nadu

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ABSTRACT

Integration of remote sensing Geographical Information System (GIS) and Global Positioning System (GPS) data for the exploration of groundwater resources has become a major breakthrough in the field of groundwater research, which assists in assessing, monitoring, and conserving groundwater resources. In this paper, an attempt has been made in the Groundwater Potential Zonation Mapping of Vasishta sub-basin in the Vellar river flowing in Salem and Perambalur districts of Tamil Nadu using geospatial technique. Primary, secondary, and field data are systematically generated. A set of thematic layers has been generated in the GIS platform, viz. geology, geomorphology, lineament density, drainage density, land use/land cover, rainfall, slope, and soil, were transformed into raster data using tools in ArcGIS. The thematical layers have been validated with the help of GPS readings, in the field and necessary corrections were carried out. Each thematical layer was assigned weightage based on the relation to the occurrence and movement of groundwater, using a quantile statistical method. The entire sub-basin has been delineated as very low, low, moderate, high, and very high groundwater potential zones. The groundwater potential zonation map is much helpful for farmers and technocrats, those who want to implement groundwater management and developmental strategy in Vasishta sub-basin.

Keywords: Vasishta sub-basin, Landuse/ Landcover, GIS, drainage density, Groundwater potential

INTRODUCTION

Water is often considered to be one of the most important resources on our planet. Groundwater is the largest obtainable resource for freshwater. Groundwater potential zonation mapping using Geospatial techniques has been

attempted by many researchers such as Groundwater is the recharge potential zones mapping using GIS and remote sensing techniques (Deepa, 2016),delineation of groundwater potential zones studies using geospatial Technology (Mohammed Musthafa, 2017) ,Remote Sensing and GIS Based groundwater potential zone mapping, (Gnanachandrasamy, 2018),Identification of groundwater potential zones in India using remote sensing, GIS and MIF techniques, (SiddiRaju ,2019) Evaluation of groundwater potential by GIS-based multicriteria decision making as a spatial prediction tool, (Recep Çelik, 2019) ,Application of remote Sensing and GIS for Groundwater Recharge Potential Zone Mapping, (Ahirwar, 2020), Delineating of groundwater potential zones based on remote sensing, GIS and analytical hierarchical process: a case, (Al-Djazouli, 2020) Delineation of groundwater potential zones using AHP and geospatial techniques, (Amit Bera, 2020) An integrated approach for mapping groundwater potential applying geospatial and MIF techniques, (Soumik Bhattacharya, 2020) Identification of Groundwater Potential Zones using Remote Sensing and GIS, (Chaudhary ,2018)Mapping groundwater potential zones using remote sensing and geographical information systems in a fractured rock setting, Southern Flinders Ranges (Fildes, 2020) Groundwater potential mapping using geospatial techniques (AbebeDebeleTolche,2020) Identification of groundwater potential zones using analytical hierarchy process (AHP) and GIS-remote sensing Integration, (HindeyaGebru, 2020) GIS and AHP Techniques Based Delineation of groundwater potential zonesIndia (Arulbalaji, 2020) Assessment of groundwater potential zones using multicriteria evaluation technique, (Rajesh Solomon Paul, 2020) Groundwater potential zone mapping using analytical hierarchy process (AHP) and GIS, (Thiyagarajan Saranya, 2020) An integrated study to delineate the groundwater potential zone using geospatial approach, (Tiwari, 2020)Mapping of groundwater potential zones in crystalline terrain using remote sensing, GIS techniques, and multicriteria data analysis, (Khalid Benjmel, 2020).Investigation of groundwater potential zone using geospatial technology, (Dawit Yehunie ,2020)

Profile of Vasishta sub-basin

Vasishta sub-basin of Vellar River basin, of Tamilnadu, which covers an areal extent of 1770.78 km^2. Vasishta is an ephemeral stream that originates from the southern slope of Kalrayan hills and flows through Kurichi, Belur, Pethanaickenpalayam, Attur, Patturai, Thalaivasal, Aragalur, Sitheri, villages of Salem and Perambalur districts of Tamil Nadu. Major and minor artificial recharge structures, which are constructed across the streams, significantly supporting groundwater recharge in the sub-basin. Rainfall is the major source of groundwater recharge in Vasishta Sub Basin. Irrigation purpose mainly depends upon the groundwater resources from dug and bore wells. (Poongodi and Venkateswaran, 2018). Base map of the study area is given in Fig.1

MATERIAL AND METHODS

The Survey of India toposheets nos 58 I/5, I/6, I/7, I/9, I/10, I/11,14, and I/15 were utilized to generate the base map at 1:50,000 scale published in 1973. Arc map 9.3 was used with extension of spatial analysis tools of IDW weightage method and different thematic layers such as geology, geomorphology, lineaments, drainage, rainfall, slope, soil, maps were prepared. Applying the weighted overlay method of all thematic layers in the GIS platform concerning the groundwater potential zonation map has been generated. During weighted overlay analysis, each class of the individual themes was given a ranking and field validation. The suitable scores were allocated under multi-influencing factor (MIF) (Ghosh et al. 2015; Manap et al. 2014). The brief flow chart is given in fig.2.

Occurrence and movement of groundwater in the Vasishta sub basin

The occurrence and movement of groundwater in the hard rock terrain and the slope for its exploitation is mainly dependent on the developments of primary and secondary porosities. The rainwater easily percolates through the weathered mantle, fissures, joints, fractures, cracks, crushed zones, fault zones, shear zones, and solution cavities which readily contribute to groundwater. The occurrence and movement of groundwater depend on the nature of

the rocks and their hydraulic parameters such as porosity, permeability, hydrologic conductivity, storativity, specific yield, and specific retention of aquifers.

METHODOLOGY

Assignment of Weightage Tand rating for the factors

Major eight influential input factors have been identified for groundwater potential zonation mapping. The major influence factors have their own influences and inter-relationship with multiple factors are categorised as major and minor effective factors X, Y. The major effective factor weightage while assigning as 1.0 and the minor effective factors weightage assigning as 0.5, The sum of Major effect lineament density, drainage density, land use/Landcover, geomorphology, and geology, and minor effect rainfall, slope, soil are considered as proposed relativeWeightage $\sum = X + Y$ and finally, the proposed course of each influencing factor derived as $\left[\frac{X+Y}{\sum=X+Y}\right] * 100$. The weightage factors and their score is given in table 1.While assigning the score for individual factors we duly consider hydrogeological connectivity of individual factors and field validities with scientific information. The influence factors and scores are taken into GIS and for overlay analysis for obtaining groundwater potential zonation maps. The map was subjected to the field check and necessary correction was carried out before the final output map. The multi influencing factors and their interrelationship are given in the flowchart .3.

Geology

Groundwater occurs under a phreatic condition in the sub-basin, the water table is mainly controlled and fluctuating owing to erratic precipitation. The farmers rely on their domestic and irrigation purpose through dug and bore wells. The effective performance of wells is controlled by interconnectivity or secondary porosity such as weathered mantle, fractures, fissures joints, and shear zones. The occurrence and movement of groundwater within the aquifer. The sub-basin encountered by the high-grade regional metamorphic rocks namely Gneiss, Charnacknite, Mylonite, Amphibolite -Pyroxene Granulite, and basic rocks is given in Fig.4. The spatial distribution for different rock units and their ranking and weightage is given in table 2.

Geomorphology

The sub-basin comes under the undulated roughed topography which includes dome-type denudational hills, dome type residual hill, inselbergs, moderately weathered buried pediplain, pediment, valley fills, ridge type structural hills, shallowly buried pediment, shallow flood plains, weathered buried pediments. Some of the geomorphic units are playing a significant role in groundwater recharge, storage, movements, and groundwater quality. The geomorphology map is presented in fig. 5.

Lineaments

Lineaments are naturally occurring linear and curvilinear features. The intersection of major lineaments is generally an indication of groundwater potential zones in the hard rock terrain (Srivastava and Bhattacharya , 2006). The lineaments are representing faulting and fissuring and lead to increased secondary porosity and permeability which is controlling groundwater storage and movements. (Kumar et al. 2007). A lineament density map has been prepared and further classified into five classes and assign weightages in the following manner, Highest rank of 12 has been given to the lineament class and low ranking is given to 1. High lineament density was usually observed at the periphery of the watershed, which is occupied by hard rocks. Lineament density is indirectly representing the groundwater recharge zone. The presence of linear structural features being favorable paths for good groundwater recharge and storage. Vasishta river and its tributaries are controlled by the minor and major lineaments. Areas with dense lineaments are suitable for groundwater developmental Planning. Lineament density was derived from the following formula,

$$\text{Lineament density} = \sum_{l=0}^{n} \frac{L_i(km)}{A\ (km)} = km^{-1}$$

Where Li=Total length of lineaments in km; A=Area of the basin in km^2. The Vasishta sub-basin lineament map and lineament density maps are presented in fig.6,7

Drainage

The drainage map has been prepared by digitizing drainages from toposheets, using the drainage delineation tool and SRTM data. Drainages are delineated in the study area and are corrected by making the comparison with toposheets in GIS environment. Each stream has given an order number following (Strahler's ,1964) stream ordering techniques, accordingly, Vasishta river has been identified as the 7th order stream. Vasishta river is flowing from the northwest to southeast direction with a length of 73 km, almost dividing the sub-basin into two halves. The tributaries are flowing from either side and merged the mainstream with an acute angle, the triangle meeting place of a main and its tributaries are considered to be groundwater potential zones, any groundwater developmental programs such as digging of new open and bore wells can be planned with proper hydrogeological investigations.

Drainage density is the total length of streams of all orders in the total drainage area. The drainage density, which is expressed as km/km^2, indicates a quantitative measure of the average length of the overland flow, and therefore, provides at least some indication of the drainage efficiency of the basin. The low value of drainage density influences greater infiltration and hence the wells in this region will have good water potential leading to the higher specific capacity of wells. In the areas of higher drainage density, the infiltration is less and surface runoff is more. The drainage density can also indirectly indicate the groundwater potential of an area, due to its surface runoff and permeability (Rama, 2014). Classification based on D_d by (Smith, 1954) found that the drainage basin belongs to the moderate textured category of drainage density. The drainage density distribution of the Vasishta sub basin is given in Fig.8, A high priority was given to a high value of drainage density, category followed by moderate, low, and very low drainage density values respectively (Magesh et al., 2012; Kaliraj et al., 2015; Thapa et al., 2017). The highest drainage density ranking 12, and the lowest drainage density is given ranking 2. The Vasishta sub-basin drainage map and drainage density maps are presented in fig.7 and 8

$$\text{Drainage density Dd} = \sum Lu/A$$

where D=Total lengths of Channels in km; A=Area of the basin in sq.km

Landuse / Landcover

Geospatial technology plays a key role in the evaluation and quantification of land-use/land cover for any region. The spatial distributions of land-use/land cover classes are dense forest plantation, hilly terrain agricultural land, a land without scrub, rocky waste, Building, salt-affected land, dry land and water bodies. Water bodies were assigned the highest weightage because of high groundwater water recharge volume and barren lands ranking giving to low groundwater percolate capacity. Agricultural lands were assigned moderate Weightage factors. The land-use/ land cover affected by the groundwater infiltration, groundwater recharge, evapotranspiration, and runoff process (Acharya and Nag, 2013). Vasishta sub-basin land-use/landcover map is presented in fig.10.

Rainfall

In Vasishta sub-basin, rainfall is the only source for recharge of surface water into the subsurface through weathered and fractured zones. Rainfall data for 10 years was then based on this data spatial distribution map has been prepared using Inverse distance weighted (IDW) tool in the Arc GIS environment. The sub-basin annual average rainfall is high < 400 mm, Medium 300-400 mm, Low 200-300 mm, and very low 100-200 mm. (Siddi Raju et al., 2018). Rainfall has given the highest rating of 7 and the lowest rating of 1. The Vasishta sub-basin rainfall is presented in fig.11.

Slope

Vasishta Sub Basin with gentle gradient of the slope is one of the factors that directly influence the infiltration of rainfall Selvam et al.(2014). The slope determines the rate of infiltration and runoff of surface water, the flat surface areas can hold and drain the water infiltrates into the ground, which can increase the groundwater recharge whereas the steep slopes increase the runoff and decrease the infiltration rate of surface water into the ground. The slope of the study area has been calculated in degree based on the DEM model which has been derived from SRTM data. The slope has been classified into five classes. Such as Gently sloping <12˚, given to the rating 12, Moderately slope 12˚-22˚, Moderately steep slope 22˚-31˚, steep slope 31˚-45˚ and Very steep slope >45˚ the lowest raking 1. In groundwater, augmentation structures give better results in the gently sloping topography which covers 1364.06 km^2. The slope map is presented in fig. 12.

Soil

The Soil plays an important role in encouraging or discouraging the recharge of groundwater and also in determining the quality parameters. The VSB is mainly underlined by alfisols, entisols, hillsols, inceptisols, vertisols , and reserved forest soils. The soil map shows that a major part of the area is covered by alfisols. Soils indicate mainly the groundwater holding level and groundwater infiltration. Based on the water holding capacity vertisols are more favorable for groundwater potential zones. Vertisols are granulated hence hold more groundwater. Alfisols favor for groundwater potential zone because this is also finely granulated and interconnected. (Deepa et al. ,2016).,The soil layer has been allocated weightage according to the characteristics of the infiltration rate to the highest rating 7 and the lowest rating 1. The Soil map is presented in fig. 13.

Groundwater Potential Zonation Map (GWPZM)

Weightages and ratings were assigned to all the influential factors and their relative subclass later than these factors were used for identification of groundwater potential zonation map through weighted overlay analysis in the GIS environment by the following equation.

GWPZ=

$$\sum_i^n \; DD_w * DD_r + G_w * G_r + GM_w * GM_r + LU\,\&LC_w * LU\&LC_r + LD_w * LD_r + R_w + R_r + Sl_w * Sl_r + S_w * S_r$$

where GWPZ=groundwater potential zones; w and r are the weightage and rating. DD = drainage density; G = geology; GM = geomorphology; LU/LC = land use/ Land cover; LD = lineament density; R = rainfall; ST = soil texture and S= slope;. Waited overlay and multi influencing factor techniques were used in preparing groundwater potential zone map in GIS software In the sub-basin very high groundwater recharge potential zone covers total area 250.51 km^2 . High groundwater recharge potential zone area combinations of geology thematic layers charnacknite and gneiss ,geomorphology such as Shallow flood plain ,pediments and Vally fill, Lineament density Low and medium, Drainage density such as high and medium drainage density, land-use/landcover such as water bodies, Agricultura land and plantation, rainfall such as high and medium, slope such as gently and moderate ,soil such as alfisols, vertisols and reserved forest total covering area 704.77 km^2 ,moderate groundwater recharge potential zone covers 266.93 km^2 and low groundwater recharge potential zone covers 517.9 km^2, low groundwater recharge potential zone covers area 266.99 km^2, Very low groundwater recharge potential zone covers 15.74,km^2, The groundwater potential zone map has been classified into four namely: Very low, low, moderate, high, very high. The groundwater potential zonation map including valley fill ,and pediplain moderate to good groundwater based on remote sensing and GIS techniques coupled with ground truth investigation, will definitely help demarcate potential groundwater zones in hard rock areas. The groundwater potential zonation map is presented in the fig. 13.

Field Validation of results

Field validation has been conducted in the entire sub-basin, the main factors are water levels in the dug and bore wells, well performance, land use/land cover pattern, and supplemented with farmer interaction information. It is clearly revealed that the areas come under the high groundwater potential zones are covered in the following villages such as Kurichchi, Pudur, Padaiyachiyur, Peddanayakkanpalaiyam, Attur, Tennagudippalaiyam, Kattukkottai etc. In highest groundwater potential zonation farmers is highly involved in the agricultural activities, owing to sufficient availability of groundwater, the water levels in the wells are shallow in nature, land use and cover patterns the farmers are mainly cultivating cash crop such as Betel leaves, tapioca tuber, cotton. Sugar cane, turmeric, coconut, banana are recent. Accuracy assessment was carried out to know the correlation between the resulting groundwater potential zones map and observed well data. Generally, a confusion matrix or error matrix is used for accuracy assessment, The overall accuracy represents based on the following formula (Jensen ,1996).

$$Overall\ accuracy = \frac{No\ of\ correct\ OWL}{Total\ No\ of\ OWL}$$

$$= \frac{72}{79} = 91\ \%$$

where OWL= Observation Well Locations. Kappa (K) analysis represents a multivariate approach for accuracy assessment and it provides a Khat statistic which means a measure of accuracy. It is calculated by following the formula (Usman et al. ,2015).

Augmenting groundwater resources in the Vasishta sub-basin the following strategies are suggested construction of check dam, percolation pond, Desilting of existing water tanks and erection of shaft in the suitable places with in the water harvesting structures.The detailed site selection mechanism based on the geological and geomorphological guidance are in fig.15

CONCLUSION

Vasishta sub-basin demonstrates that the integrated use of geospatial and geophysical techniques is an efficient tool for assessing groundwater potential, based on which suitable locations for groundwater withdrawals could be identified. The methodology has been designed with integration of important indicating multi influencing factors of groundwater like geomorphology, geology, land use/land cover, lineament density and, drainage density, slope soil, and rainfall for exploration of groundwater potential zones at the watershed scale. The results reveal that the area falls in five groundwater potential zones ranging from Very Low, Low, Moderate, High, Very High area such as Kurichchi, Pudur, Padaiyachiyur, Peddanayakkanpalaiyam, Attur, Tennagudippalaiyam, Kattukkottai, ChenniMalai, Tyaganur, Nadar Agraharam, Vellaiyur, Sitteri, Kugaiyur, Kariyanur, Kaikalathur, Vadakarampoondi, Keelkalpoondi, and Tiruvalandurai. The Very Low zone is indicative of the least favorable region for groundwater prospecting such as Palaniyapuram, Jampoothumalai, Puluthikottai, Thumbal, Mudiyanur, Ponnarampatti, Iswaramoorthipalaiyam, Kakarampatti, Ayelpatti, Pusariyur, while the Moderate to very high zone indicates the most favorable region. Implementing artificial groundwater recharge structure in the selected area will improve the groundwater resources in the lesser groundwater zones.

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Table :1 Major and Minor influencing factor for occurrence and movement of groundwater

Factor	Major effect (X)	Minor effect (Y)	Proposed relative weight $\sum = X + Y$	The proposed course of each influencing factor $\left[\frac{X+Y}{\sum = X+Y}\right] * 100$
Geology	1	1	2	10
Geomorphology	2	1	3	15
Lineament density	3	0.5	3.5	17
Drainage density	2	0.5	2.5	12
Land use/land cover	3	0.5	3.5	17
Rainfall	1	0.5	1.5	7

Slope	1	1.5	2.5	12
Soil	0	1.5	1.5	7
			20.5	

Table 2: Theme weight and class rank assigned to different thematic layers in weighed overlay analysis

Theme	Class	Spatial Distribution in km²	Individual Rating	Weightage
Geology	Gneiss	1191.40	8	10
	Charnockite,	535.74	10	
	Amphibolite -Pyroxene Granulite,	22.68	5	
	Basic rocks and Mylonite	6.11	7	
Geomorphology	Shallow Flood plain	4.9	15	15
	Dome type Denudational hills	43.64	1	
	Dome type Residual Hill,	15.3	1	
	Inselberg	5.83	2	
	Moderately Weathered/	315.55	5	
	Moderately Buried Pediplain,	385.19	4	
	Pediment / Valley floor,	211.53	10	
	Shallow Buried Pediment	104.2	4	
Lineament density	Low lineament density	677	12	12
	Medium lineament density	392	8	
	High lineament density	471	5	
	Very high lineament density	181	1	
Drainage density	Very low drainage density	211	2	12
	Low drainage density	677	5	
	Medium drainage density	613	8	
	High drainage density	247	12	
Land use/ Landcover	Dense forest	156	4	17
	Plantation	137	8	
	Hilly terrain	106	3	
	Agricultural land	115	10	
	land without scrub	174	2	
	Rocky waste	154	1	
	Building	179	1	
	Salt affected land	189	2	
	Dryland	299	1	
	Water bodies	36	17	
Rainfall	High	44.63	7	7
	Medium	390.61	5	
	Low	1211.42	3	
	Very Low	122.03	1	
Slope	Gently sloping	245.5	12	12
	Moderately slope	157.3	10	
	Moderately steep slope	1364.06	2	
	Very steep slope	304	1	

Soil	Hill sols	122.62	1	7
	Inceptisols	19.89	2	
	Reserve forest	451.56	5	
	Entisols	491.51	4	
	Alfisols	526.69	7	
	Vertisols	118.62	5	

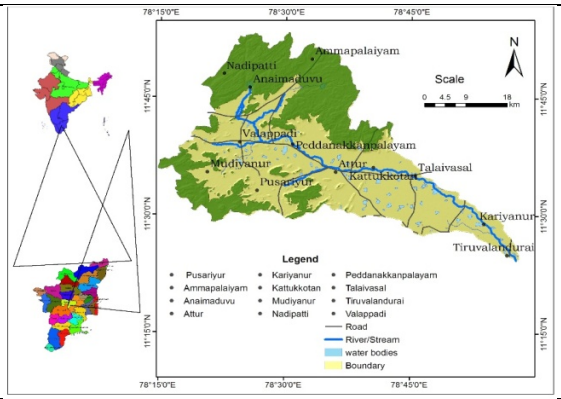

Fig.1 Base map of Vasishta Sub-basin

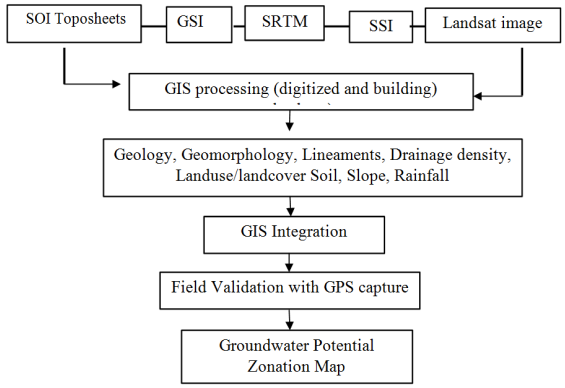

Fig.2 Flow chart of groundwater potential zonation map

Note: Survey of India(SOI), Geological Survey of India (GSI), Shuttle Radar Topography Mission (SRTM), Geographical Information System (GIS), Global Positioning System (GPS), the survey of Soil India (SSI)

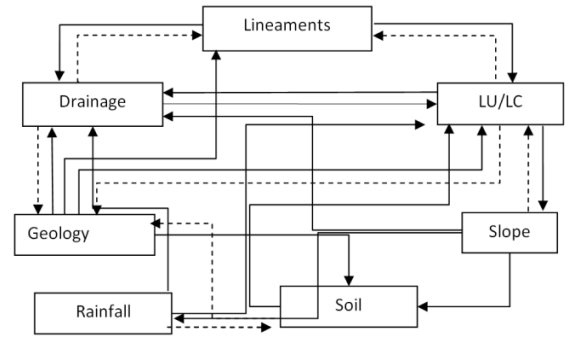

Fig.3 Interrelationship between the multi influencing factors

Note: Major Effect= Minor Effect =

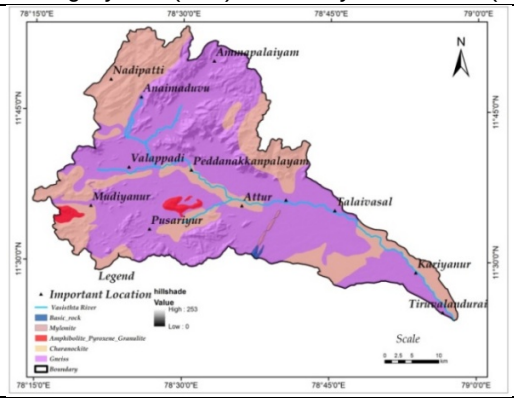

Fig.4 Geology map of the Vasishta Sub Basin

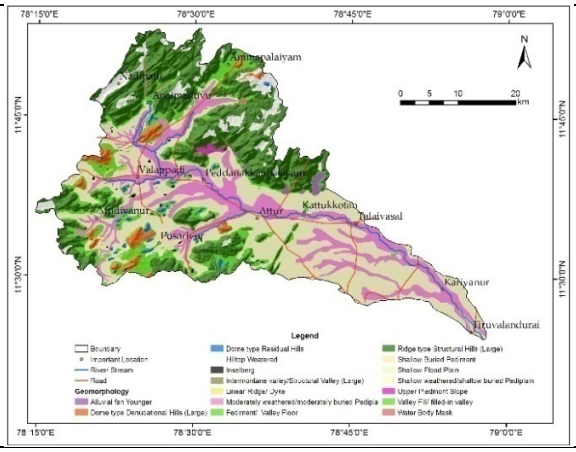

Fig.5 Geomorphology map of the Vasishta Sub Basin

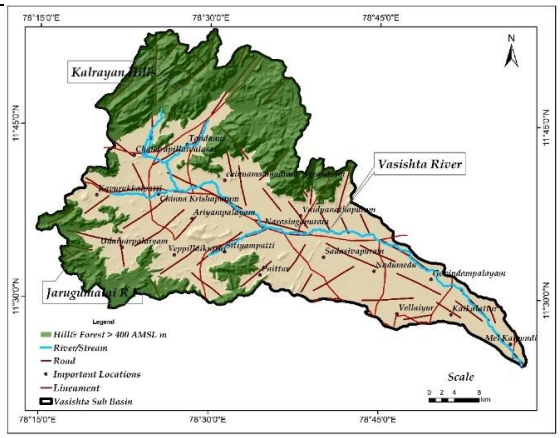

Fig.6 Lineamnet map

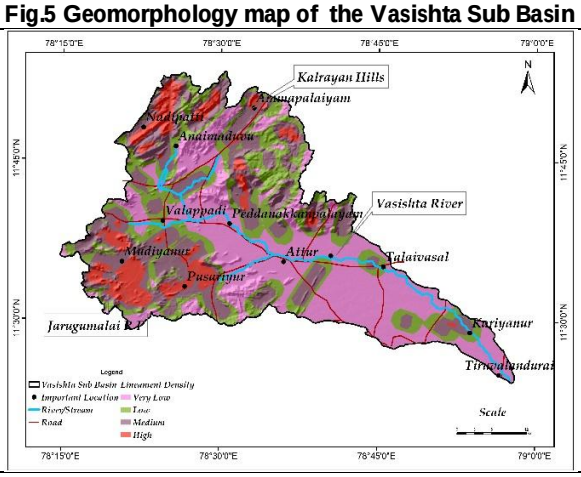

Fig.7 Lineament density map

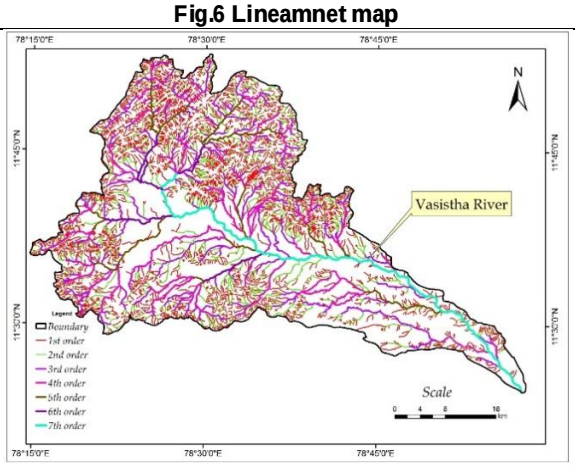

Fig.8 Drainage map

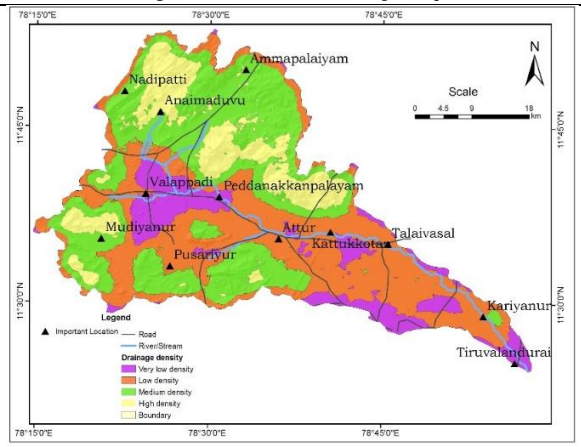

Fig.9 Drainage density map

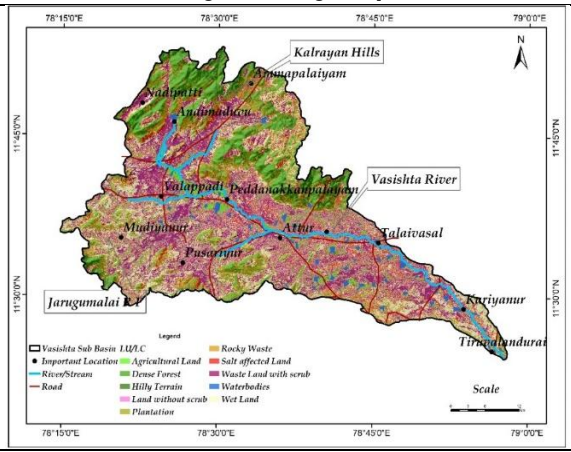

Fig.10 Landuse/landcover map

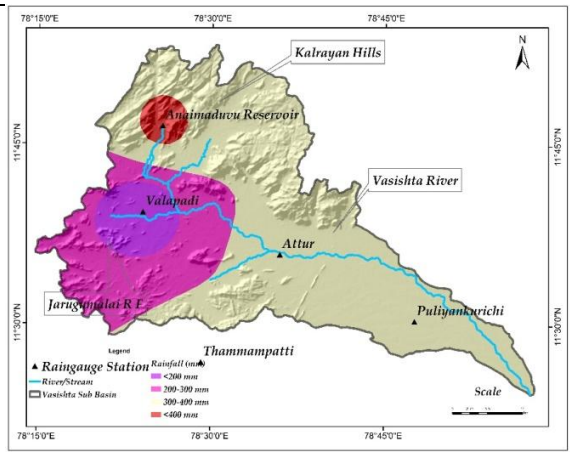

Fig.11 Rainfall map

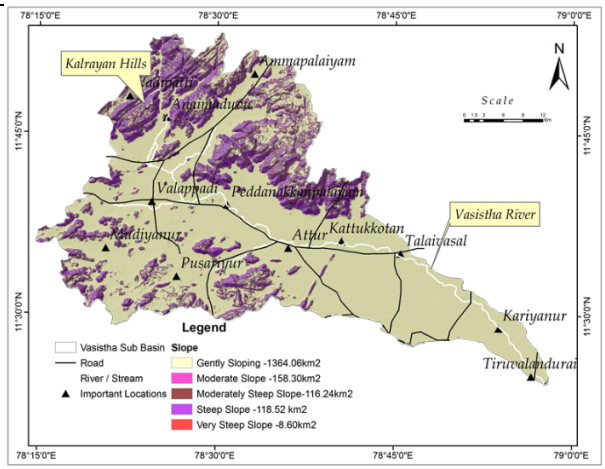

Fig.12 Slope Map

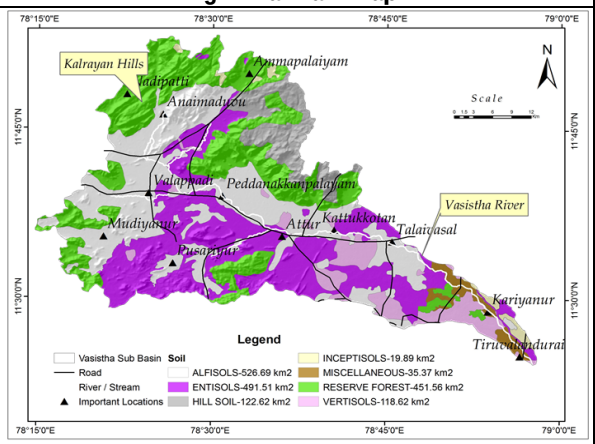

Fig.13 Soil map

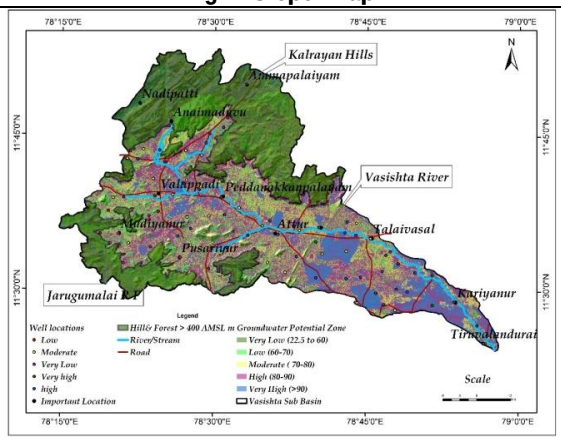

Fig.14 Groundwater potential zonation map

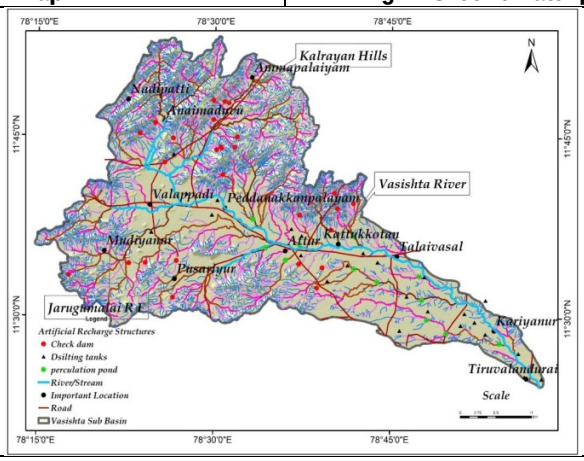

Fig.15 Proposed artificial recharge structures of the Vasishta sub-basin

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RESEARCH ARTICLE

Evaluation of Leaf Fraction of *Annona reticulata* Linn. for Antioxidant Activity and Anti-Inflammatory Potential against Carrageenan Induced Rat Paw Edema Model

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ABSTRACT

Annona reticulata Linn. is well-known for its health-promoting properties. Plant parts such as the leaves, bark, seed, and root of this plant are utilised as folk medicine in Assam's rural areas to cure a variety of diseases. *Annona reticulata* leaves were gathered, identified, dried, and ground into a coarse powder before being extracted with methanol. The methanolic extract was fractionated using various solvent treatments. Antioxidant activity was measured using DPPH free radical scavenging activity, H_2O_2 scavenging activity, and Nitric oxide radical scavenging activity in methanolic extract. The anti-inflammatory properties of bioactive components of Annona reticulata leaves crude methanolic extract (ME) were assessed utilising a carrageenan-induced rat hind paw edema model of inflammation. The antioxidant activity revealed that the fractions had a concentration-dependent scavenging effect. The fractions F2 and F3 showed the best anti-inflammatory results, as well as a reduction in proinflammatory cytokines. At all times of observation, the anti-inflammatory activity of fractions F_2 and F_3 was significant ($P<0.01$) at all the observation times (1-3h). Outcome of findings demonstrate the anti-inflammatory and anti-oxidant potential of the isolates/fractions of *A. reticulata*, which were found enriched in polyphenolics including Quercetin and Gallic acid; and provides logistic behind the traditional use of the *Annona reticulata* against inflammations and wound healing. In conclusion, the leaves of *Annona reticulata* could be beneficial in the management of different inflammatory disease states.

Key words : *Annona reticulata*, Inflammation, Carrageenan, Quercetin and Gallic acid.

INTRODUCTION

Plants have played a crucial part in medicine development. Natural products account for around a third of all medicine sales worldwide. Innovation in therapeutic target elucidation and lead structure discovery is predicted to drive various techniques to improve and speed the drug discovery and development process[1]. Nonsteroidal anti-inflammatory medications are one of the most used drug classes worldwide. Inflammation is a feature of the

immunological response to infection and has been linked to diabetes, cancer, hypertension, and atherosclerosis, among other disorders. Diabetes affects 346 million individuals around the world. People have employed medicinal plants to treat diseases and illnesses like diabetes throughout history. It's worth noting that several anti-diabetic herbs also have anti-inflammatory properties [2]. *Annona reticulate* Linn. has been has been claimed in traditional Ayurvedic medicine to have a wide range of applications in the treatment of pain and inflammation.. Aqueous leaf extract of *Annona reticulata* has also been shown to reduce hyperthyroidism, which is commonly thought to be a cause of diabetes mellitus. As a hypoglycemic agent, decoction of leaves with water can be utilised. [3]. The plant is mainly used for the treatment of epilepsy, dysentery, inflammations, diabetes, cardiac problems, worm infestation, constipation, haemorrhage, antibacterial infection, dysuria, fever, ulcer etc [4,5]. The present study was designed to investigate anti-oxidant and anti-inflammatory activity of different fractions of methanolic extract of leaves of *Annonareticulata* Linn with an aim to justify its role in the treatment of inflammatory diseases.

MATERIALS AND METHODS

Collection and Authentication of the Plant material

Leaves of *Annona reticulata* Linn. were collected in the month of October 2014 from Dibrugarh district of Assam. The plant was authenticated by Dr. B.K. Sinha, Botanical Survey of India, Shillong. A voucher specimen was submitted as herbarium with voucher specimen no. DU/PSc/HRB-01/2011 and deposited at the same institute for further reference.

Preparation of fractions

2kg of powdered material was extracted in soxhlet apparatus with solvents of increasing order of polarity ie. Petroleum ether, ethyl acetate, acetone. methanol and water. Extracts were dried in rotary evaporator and weighed. All these extracts were then subjected for *in vitro* antidiabetic evaluation as mentioned in our previous research papers [6] the most potential one among the five solvent extracts of the plant, that is, methanolic extract of *Annona reticulata Linn.* was selected for further *column chromatography*. 100 g of Methanolic extract was subjected for isolation of bioactive molecules through Column chromatography.Column was run with different solvents from non polar to polar i.e. Petroleum ether, ethyl acetate and methanol[7].Fractions were collected and pooled together on the basis of similar results and the solvent was removed. They were then dried, weighed and analyzed.

Evaluation of Anti-oxidant activity [8,9,10&11]

DPPH radical scavenging activity

The DPPH (1, 1-Diphenyl –2-picrylhydrazyl) assay is based on the reduction of DPPH, a stable free radical. The free radical DPPH with an odd electron gives a maximum absorption at 517 nm (purple color). When Antioxidants react with DPPH, which is a stable free radical becomes paired off in the presence of a hydrogen donor (e.g., a free radical-scavenging antioxidant) and is reduced to the DPPH and as consequence the absorbance's decreased from the DPPH. The stock solution of extracts and ascorbic acid (standard compound) were prepared in methanol to achieve the concentration of 1 mg/ml, then it was diluted to different concentration. 1 ml each of the diluted solutions were in a test tube and mixed with 1 ml of methanolic solution of DPPH in concentration of 1 mg/ml. After 30 min incubation in darkness at room temperature, the absorbance was recorded at 517 nm.

$$\% \text{ inhibition} = \frac{\text{Absorbance of control} - \text{Absorbance of sample}}{\text{Absorbance of control}} \times 100$$

Nitric oxide free radical scavenging activity

The principle behind this procedure is that sodium nitro-prusside in aqueous solution at physiological pH spontaneously generates nitric oxide which interacts with oxygen to produce nitrite ions that can be estimated using Griess reagent. Scavengers of nitric oxide compete with oxygen, leading to reduced production of nitrite ions. Large amounts of NO may lead to tissue damage.

The stock solution of extracts and ascorbic acid (standard compound) were prepared in methanol to achieve the concentration of 1 mg/ml, then it was diluted to different concentration. 0.5 ml each of the diluted solutions were taken in a separate test tube. To each tube 2.0 ml of sodium nitroprusside (10 mM) in phosphate buffer saline was added. The solutions were incubated at room temperature for 150 minutes. The similar procedure was repeated with methanol as blank which served as control. After the incubation, 5 ml of griess reagent (1% sulphanilamide, 2% H_3PO_4 and 0.1% naphthylethylenediaminedihydrochloride) was added to each tube including control. The absorbance was measured at 546 nm on UV-visible spectrometer Shimadzu, UV-1800, Japan.

$$\% \text{ inhibition} = \frac{\text{Absorbance of control} - \text{Absorbance of sample}}{\text{Absorbance of control}} \times 100$$

Hydrogen Peroxide Scavenging activity

The ability of the extracts to scavenge hydrogen peroxide was determined according to the method . A solution of hydrogen peroxide (40 mM) was prepared in phosphate buffer (pH 7.4). Extracts (100 µg/mL) in distilled water were added to a hydrogenperoxide solution (0.6 mL, 40mM). Absorbance of hydrogen peroxide at 230 nm was determined 10 minutes later against a blank solution containing the phosphate buffer without hydrogen peroxide. The percentage of hydrogen peroxide scavenging of both C. monogyna extracts and standard compounds were calculated:

$$\% \text{ inhibition} = \frac{\text{Absorbance of control} - \text{Absorbance of sample}}{\text{Absorbance of control}} \times 100$$

.

Anti-inflammatory studies:

Anti-inflammatory activity of the five different extracts of leaves of *Annona reticulata* Linn. were carried out by Carrageenan induced rat paw edema method in adult Wister albino rats[12,13].

Chemicals and fractions

Carrageenan (Himedia labs, Mumbai), Celecoxib (standard NSAID, gift sample from Jagat Pharma Ltd.), Isolated fractions - F_1, F_2, F_3 and F_4 and sandwich ELISA kit.

Apparatus

Microcapillary tubes, microtips (Tarson, India), test tubes, centrifuging tubes (Tarson, India), tissue paper, micropipettes were purchased from authorized vendors.

Instruments used

Plethysmometer, UV/Visible spectrophotometer, Eppendorff's cryocentrifuge machine.

Preparation of dosage form

a. Vehicle

Vehicle was prepared by adding 2% tween 80 into distilled water.

b.Isolated fractions

The solvent free residue of each isolated fraction (200 mg/kg) was dissolved in 10 ml of 2% tween 80 to prepare stock solution of 20 mg/ml respectively. Required volume is made up by gradual addition of distilled water. Then, the desired doses of the isolated fractions were administered according to the body weight of the rats in respective groups.

C. Standard Drug

Accurately weighed quantity of Celecoxib (10mg/kg) was dissolved in 10 ml of 2% tween 80 to prepare stock solution of 1 mg/ml.

Storage

All the dosage forms of extracts and drug solutions were prepared freshly on the day of dosing and stored in airtight amber colored vials to protect from exposure to sunlight during the experiments.

Volume of extract solution

The volume of extract solution was calculated based upon the body weight of animal.

Route of administration

The extract solutions and standard drug were administered per orally.

Selection of Animals

Adult Male Wistar rats weighing about 150–200 gm were used for the study. All studies were performed in accordance with the guidance for the care and use of laboratory animals, as adopted and promulgated by the Institutional Animal Care Committee, CPCSEA, India (Approval No. IAEC/DU/102, Dated: 06/08/2015) under strict compliance of the Committee for the Purpose of Control and Supervision of Experiments on Animals guidelines.

Maintenance and Acclimatization of Animals

The animal house was well ventilated and animals were housed in spacious, labeled cages at 24°C ± 2°C, and maintained under RH 44–56% and standard 12 h light/12 h dark cycle throughout the study. They were given access to rodent pellet and water *ad libitum*.

Acute toxicity study

Acute toxicity study was carried out in female albino rats for all the four isolated fractions according to OECD guideline no-425. All the four fractions were taken at various dose levels *i.e.* 175,550 and 2000mg/kg body weight dissolved in 0.5% carboxymethyl cellulose. The effective dose (ED_{50}) of all the four fractions was decided 1/10 of maximum dose .

Anti-inflammatory activity Evaluation

Anti-inflammatory activity of the four different isolated fractions were carried out by Carrageenan induced rat paw edema method in Wister albino rats. Animals were divided into 6 different groups containing 6 rats in each group.1st group was inflammatory control, 2nd was treated with standard drug celecoxib at a dose of 10 mg/ kg intraperitonially. Other four groups were treated with four Fractions F_1, F_2 , F_3 and F_4 at a dose of 200 mg/kg b.w. orally. After 1hr of treatment animals were injected with 0.1ml of 1% w/v suspension of Carrageenan in the sub-planter region of right hind paw of the rats. Paw volume were measured every hour till 3hr after carrageenan injection by plethysmometer(Figure 4,5 and 6). Inhibitory activity of the extracts and the standard drug were measured by the formula-

$$\text{Percent Inhibition} = \frac{VC - VT}{VC} \times 100$$

Where, VC = The mean increase in paw volume in control group

VT = The mean increase in paw volume in treated group

Evaluation of serum inflammatory markers

Serum levels of pro-inflammatory TNF-α, IL-6 and IL-8 and anti-inflammatory IL-4 and IL-10 were assessed using commercial sandwich ELISA kits according to manufacturer's instructions. At the end of treatment in anti-inflammatory study, three rats in each group were used for the cytokine analysis. Fresh whole blood is drawn from the retro-orbital plexus of rats into heparinized tubes. Serum was isolated from the blood after centrifugation at 5000 rpm for 15 to 20 min and was frozen at −20°C until enzyme-linked immunosorbent assay (ELISA) analyses were performed. The levels of inflammatory mediators in the serum samples were quantified using specific ELISA kits for rats according to the manufacturers' instructions (BD Biosciences, San Diego, CA, USA).

Statistical Analysis

All the values are expresses as mean ± SEM, n=6. Data were analyzed by One-way ANOVA, using Graph pad INSTAT. The post-hock analysis was carried out by using Dunnet's multiple comparison tests.

RESULTS AND DISCUSSION

Isolation and separation of phytoconstituent from leaves of *Annona reticulata* Linn. was carried out using column chromatographic method.Methanolic extract of leaf of *Annona reticulata* Linn. was subjected for isolation of bioactive molecules through Column chromatography.Total about 21 fractions were collected from their sub fractions using increasing polarity of solvents . These fractions were pooled up from their sub fractions of their respective solvent ratios based on same R_f value. Four fractions were screened for their biological activities based on their reports in TLC. They are: F_1(Pet ether: Ethyl acetate, 8:2), F_2(Pet ether: ethyl acetate,2:8), F_3(Ethyl acetate: methanol, 4:6) and F_4(pure methanol). TLC of the four fractions F_1, F_2, F_3 andF_4 are presented in Table 1 and Figure 1,2,3&4. The four fractions F_1 (Pet ether: Ethyl acetate 8:2), F_2 (Pet ether: ethyl acetate 2:8), F_3(Ethyl acetate : methanol 4:6) and F_4(pure methanol) obtained from column chromatography of methanol extract were tested for their biological activities.

Anti-oxidant activity

The four fractions F_1, F_2, F_3 and F_4 were evaluated for their *in-vitro* anti-oxidant activity in different radical scavenging models.

DPPH free radical scavenging activity

Radical scavenging ability of the four fractions were determined by DPPH radical scavenging assay. The DPPH is stable free radicals which get reduced in presence of antioxidant compound that intern decreases absorbance ability of DPPH at 517 nm (Table 2 and Figure 5).

The radical scavenging activity of the fractions and standard ascorbic acid on DPPH was expressed as IC_{50} value. It was observed that free radicals were scavenged by the test fractions in a concentration dependant manner upto the given concentration. The results of DPPH radical scavenging activity of the fractions F_1, F_2, F_3 and F_4 showed that F_2 and F_3 posses very strong antioxidant activity.

The maximum percent inhibition of DPPH by F_2 and F_3were 68.11% and 63.71% respectively at 200µg compared to standard ascorbic acid with percent inhibition of 73.67%. The IC_{50} value of the F_1, F_2, F_3 and F_4 were 196.63µg/ml, 102.41µg/ml, 155.14µg/ml and 306.87µg/ml respectively and Ascorbic acid was 25.87µg/ml.

Hydrogen peroxide (H_2O_2) scavenging activity

The scavenging activity of the four fractions of methanolic extract and standard, Ascorbic acid on H_2O_2 was expressed as IC_{50} value. H_2O_2 scavenging effect of *Annona reticulata* Linn. leaf extracts and ascorbic acid were found to be dose dependant with maximum inhibition at highest concentration (Table 3 and Figure 6). The ability of the fractions of methanolic leaf extracts to scavenge hydrogen peroxide is shown in Table 16 and compared with that of ascorbic acid as reference standard. The four fractions showed dose dependent H_2O_2 scavenging activity as that of ascorbic acid. In H_2O_2 radical scavenging model the maximum percent inhibition of H_2O_2 radical by F_2 and F_3 were 69.32% and 56.71% respectively at 200µg as compared to standard ascorbic acid with 78.60% inhibition.

F_1 and F_4 were less significant as compared to standard ascorbic acid. The IC_{50} value of the F_1, F_2, F_3 and F_4 were 187.98µg/ml, 100.76µg/ml, 143.65µg/ml and 321.98µg/ml respectively and Ascorbic acid was 31.65µg/ml.

Nitric-oxide radical scavenging assay

In Nitric-oxide radical scavenging model the maximum percent inhibition of Nitric oxideradical by F_2 and F_3 were 68.62% and 56.71% respectively at 200μg as compared to standard ascorbic acid with 79.10% inhibition (Table 4 and Figure 7). Nitric oxidescavenging effect of fractions of Methanolic extract of *Annona reticulata* Linn. and ascorbic acid were found to be dose dependant with maximum inhibition at highest concentration. Fractions F_1 and F_4 were less significant as compared to standard ascorbic acid. The IC_{50} value of the F_1, F_2, F_3 and F_4 were 176.87μg/ml,98.76 μg/ml, 142.87μg/ml, and 298.76μg/ml respectively and Ascorbic acid was 27.63 μg/ml.

Statistical Analysis

The data were subjected to statistical analysis. All the values are expresses as Mean ± SEM and data was analyzed by One-way ANOVA, using Graphpad INSTAT. The post-hock analysis was carried out by Dunnet's multiple comparison tests to estimate the significance of difference between individual groups (**$^{**}P<0.01$). IC_{50} value was calculated by plotting a graph with percent inhibition on y-axis and concentration on x-axis**.**

Acute toxicity study

The acute toxicity study of the four fractions were carried in adult female albino rats by "fix dose" method of OECD Guideline No. 425. All the four fractions of methanolic extract of leaf of *Annona reticulata* Linn. were taken at various dose levels i.e. 175, 550 and 2000 mg/kg body weight. Administration of maximum dose 2000 mg/kg, p.o. of all the four fractions did not produce any behavioral abnormalities and mortality.The effective dose (ED_{50}) of all the four fractions was decided 1/10 of maximum dose *i.e*. 200mg/kg body weight.

Evaluation of Anti-inflammatory activity of the isolated fractions

The anti-inflammatory activity of thefour fractions F_1, F_2, F_3 and F_4 were carried out in carrageenan induced rat paw edema model. A significant dose dependent anti-inflammatory activity of all four fractions was observed. The anti-inflammatory effect of thefour fractions revealed that F_2 was found to be the most potent in reducing the inflammation (44.09% inhibition at 3rd hour). It significantly ($p<0.01$) reduced the paw edema at 3rd hour (Table 5). However, F_1, F_3 and F_4(200 mg/kg) also showed significant ($p<0.01$) inhibition in paw volume at 3rd hour with 41.72%, 34.41 % and 35.71% inhibition when compared to carrageenan control group. Celecoxib (10 mg/kg) caused significant ($p<0.01$) inhibition of increase in paw volume at 2nd and 3rd hour. The inhibitory effect of the celecoxib at 10 mg/kg was 52.57 % at 3rd hour (Table 6 and Figure 8).

Fraction F_3 , $F_1$and F_4 were also found to be active in reducing the inflammation but less active than F_2.They were less effective as compared to standard drug celecoxib (10mg/kg) produced percent inhibition of 53.95% . The anti-inflammatory activity of the fractions may be attributed due to the presence of flavonoids and phenolic compounds. Serum levels of pro-inflammatory cytokines TNF-α, IL-6, IL-8 and anti-inflammatory cytokines IL-4 and IL-10 were assessed for all the four fractions using commercial sandwich ELISA kits(Table 7).

Among the four fractions tested it was found that the fractions F_2 andF_3 exerted the highest decrease in IL-6, IL-8 and TNFα when compared with the standard drug celecoxib which showed marked decrease in IL-6, IL-8 and TNFα. The condition gets reversed in case of IL-4 and IL-10.Standard drug celecoxib showed marked increase in IL-4 and IL-10 (Table 7). Fraction F_2 exerted significant increase in levels of IL-4 and IL-10.This study explains the significant effect of fractions F_2 and F_3 on inhibition of inflammation by lowering the level of pro inflammatory cytokines and increasing the level of anti-inflammatory cytokines.

DISCUSSIONS

Methanolic extract was found to be most potent against all the biological activities and subjected for column chromatography for isolation of bioactive compounds. A total of 21 fractionswere collected and out of these four

fractionswere tested for their biological activities. They are -F_1 (Pet ether: Ethyl acetate 8:2), F_2 (Pet ether: ethyl acetate 2:8), F_3(Ethyl acetate : methanol 4:6) and F_4(pure methanol)which are purified by repeated recrystalization. The four fractions F_1, F_2, F_3 and F_4 were tested for their *in vitro* antioxidant activity in DPPH, H_2O_2 and Nitric oxide radical scavenging models. It was observed that free radicals were scavenged by the test fractions in a concentration dependant manner upto the given concentration. The results of radical scavenging activity in all the three in-vitro methods by the fractions F_2 and F_3 were very promising.F_2 showed the highest DPPH,H_2O_2 and Nitric oxide reducing activity based on its relatively low IC_{50} values which was comparable with Ascorbic acid.

The anti-inflammatory activity of the isolated fractions were evaluated using the carrageenan induced paw edema method.Carrageenan is a family of linear sulphated polysaccharides extracted from the red seaweed marine alga Chondrus crispus. Inflammation induced by carrageenan is an acute and highly reproducible inflammatory model. Carrageenan has been widely used as an inflammagen capable of inducing experimental inflammation[14]. All the four fractions of *Annona reticulata* were found to be non toxic in their highest dose in acute toxicity study. The anti-inflammatory activity of thefour fractions F_1, F_2, F_3 and F_4 were carried out in carrageenan induced rat paw edema model. Among the four fractions F_2 and F_3 showed significant percent inhibition of 58.33% and 50.46% inhibition respectively. There was significant dose dependent anti-inflammatory activity of all four fractions. Other two fraction were less effective as compared to standard drug celecoxib (10mg/kg) percent inhibition of 62.50%.The induction of edema by using carrageenan is believed to be biphasic in nature. The first phase involved within 1 h of carrageenan administration is associated with the release of histamine and serotonin from mast cells. The second phase starts after 1 h and is characterized by an increased release of prostaglandins (PGs) in the inflammatory area. During the second phase, the macrophages are known to release the large amounts of interleukin-1 (IL-1) which led to the increased accumulation of polymorphic nuclear cells (PMNs) to the site of inflammation. The activated PMNs then release the lysosomal enzymes and active oxygen species to destroy connective tissue and induce paw swelling[15]. Statistical analysis revealed that F_2 (200mg/kg) and F_3 (200mg/kg) significantly($p<0.01$) inhibited the development of paw edema induced by carrageenan from 2h onwards. Therefore it may be assumed that F_2 and F_3 are associated with inhibition of later phase. Moreover, Celecoxib (10 mg/kg) exhibited an enhanced effect of inhibiting the paw edema than F_2 andF_3 with 62.50% inhibition at 2 h and3 h.

Serum levels of pro-inflammatory cytokines TNF-α, IL-6, IL-8 and anti-inflammatory cytokines IL-4 and IL-10 were also assessed for all the four fractions using commercial sandwich ELISA kits. Among the four fractions tested it was found that the fraction F_2 andF_3 exerted the highest decrease in IL-6, IL-8 and TNFα when compared with the standard drug celecoxib which showed marked decrease in IL-6, IL-8 and TNFα.The condition gets reversed in case of IL-4 and IL-10.Standard drug celecoxib showed marked increase in IL-4 and IL-10. Fraction F_2 exerted significant increase in levels of IL-4 and IL-10.This study explains the significant effect of fraction F_2 and F_3 on inhibition of inflammation by lowering the level of proinflammatory cytokines and increasing the level of anti-inflammatory cytokines.

Among the four fractions F_2 and F_3 were found to have significant biological activity compared to F_1 and F_4.Two pure bioactive compounds K_1 and K_2 have been isolated from fraction F_2 and F_3. Compound K_1 and compound K_2 were identified and characterized by analytical techniques such as Melting point, UV, NMR, FTIR and Mass spectrometry.Spectral analysis revealed that K_1 and K_2 are Quercetin and Gallic acid respectively which are naturally occurring potent anti-oxidants with diverse pharmacological activities[16].Structure of compound K_1andK_2have been elucidated from obtained results which were compared with reported values of Gallic acid and confirmed.

Quercetin and Gallic acid are naturally occurring potent anti-oxidants with diverse pharmacological actions. They are known for their anti-diabetic, anti-inflammatory and cardioprotective activity. They are unique biological elements of the flavonoid and phenolic group contain potential mental and physical health benefits. This plant could be useful for the treatment the complications of diseases associated with inflammation and free radicals.

CONCLUSION

With extensive pharmacological and biological activities of bio-flavonoids and phenolic compounds gain appreciable attention in the treatment of diseases associated with inflammations like diabetes, cancer and other chronic disorders. Among several beneficial flavonoids, Quercetin exhibits impressive anti-inflammatory effects with significant improvement of rise in levels of anti-inflammatory cytokinines without producing serious health hazards. The leaves of *Annona reticulata* is a good source of Quercetin and Gallic acid. It could be a potential source of nutraceutical and natural antioxidant. Commercialization of these bioactive marker compounds from the leaves of *Annona reticulata* Linn. will be a an excellent pool of molecules for the production of nutraceuticals, functional foods, and food additives. The pharmacological activities reported here validate the traditional use of this plant against inflammatory conditions and oxidative damage and supports the use of *Annona reticulata* in the treatment of inflammatory diseases linked with diabetes and cardiovascular diseases.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Institutional Animal Care Committee, CPCSEA, India. The institutional registration number is 1576/GO/a/11/CPCSE dated: 17/2/2012. The present study is approved vide Approval No. IAEC/DU/102, Dated: 06/08/2015.

HUMAN AND ANIMAL RIGHTS

All procedures performed in studies involving animals were in accordance with the ethical standards promulgated by the Institutional Animal Care Committee, CPCSEA, India. The institutional registration number is 1576/GO/a/11/CPCSE dated: 17/2/2012. The present study is approved vide Approval No. IAEC/DU/102, Dated: 06/08/2015.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

Not applicable.

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INTEREST

The authors declare no conflict of interest, financial or otherwise.

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Table 1: TLC of fractions eluted using column chromatography

Sl. No	Fraction	Description	R_f	No of spot	Figure
1	F_1	Light green band	-	No spot	1
2	F_2	Light orange colored band	0.65	One fluorescent spot	2
3	F_3	Light yellow colored band	0.60	One magenta color spot	3
4	F_4	Colourless band	-	No spot	4

Table 2:DPPH radical scavenging activity of the four fractions of Methanolic leaf extract of *Annona reticulata* Linn.

Conc. (µg/ml)	Percentage Inhibition				
	F_1	F_2	F_3	F_4	Ascorbic acid
25	33.01±0.02	40.25±0.05**	31.11±0.02**	21.01±0.06**	56.01±0.03
50	45.17±0.09	51.97±0.05	42.95±0.04**	30.39±0.03	60.19±0.07
100	50.09±0.11	57.23±0.13	50.17±0.10	29.17±0.09**	68.59±0.06
200	56.01±0.04	68.11±0.06	63.71±0.07	40.14±0.05**	73.67±0.04

Values are expressed as Mean ± SEM; (n = 6); One Way ANOVA followed by Dunnet's Multiple Comparison test; **p<0.01 vs. standard drug

Table 3:H_2O_2Radical scavenging Activity of the four fractions of Methanolic leaf extract of *Annona reticulata* Linn.

Conc. (µg/ml)	Percentage Inhibition				
	F_1	F_2	F_3	F_4	Ascorbic acid
25	20.09±0.05	34.75±0.09**	30.95±0.08	26.07±0.07	56.01±0.05
50	25.87±0.13	39.06± 0.11	36.56±0.15	32.47±0.10	60.19±0.09
100	37.56±0.06	46.67±0.10	43.07±0.09	38.41±0.06	68.59±0.03
200	49.05±0.03	69.32±0.09	56.71±0.06	45.87±0.10	73.67±0.08

Values are expressed as Mean ± SEM; (n = 6); One Way ANOVA followed by Dunnet's Multiple Comparison test; **p<0.01 vs. standard drug

Table 4: Nitric oxide Radical scavenging Activity of the four fractions of Methanolic leaf extract of *Annona reticulata* Linn.

Conc. (µg/ml)	Percentage Inhibition				
	F_1	F_2	F_3	F_4	Ascorbic acid
25	31.56±0.06	34.78±0.08	29.76±0.10	21.09±0.05	56.01±0.12
50	37.58±0.09	42.06±0.11	32.56±0.05	26.65±0.07**	60.19±0.09
100	42.45±0.11	49.32±0.03	38.06±0.08	31.05±0.11	68.59±0.15
200	49.56±0.15	68.62±0.18	61.71±0.12	38.74±0.09	73.67±0.14

Values are expressed as Mean ± SEM; (n = 6); One Way ANOVA followed by Dunnet's Multiple Comparison test; **p<0.01 vs. standard drug

Table 5: Effect of Fractions of *Annona reticulata* Linn on Carrageenan induced paw edema in rats

Treatment	Increase in paw volume in ml for			
	0 hr	1hr	2hr	3hr
Inflammatory control	1.22±0.04	1.86±0.04	2.48±0.01	2.78±0.04
Celecoxib (10mg/kg)	1.23±0.03	1.48±0.07	1.41±0.03	1.28±0.03
F_1(200mg/kg)	1.24±0.07	1.68±0.03	1.80±0.04	1.74±0.05
F_2(200mg/kg)	1.23±0.05	1.58±0.03	1.65±0.05	1.57±0.05
F_3(200mg/kg)	1.23±0.04	1.68±0.05	1.76±0.03	1.62±0.03**
F_4(200mg/kg)	1.22±0.03	1.86±0.05	1.80±0.04	1.79±0.03

Values are expressed as mean ± SD; n=6 rats per group.One way ANOVA followed by Dunnet's Multiple Comparison test; when compared with standard control **p<0.01

Table 6: Effect of isolated fractions on Carrageenan induced paw edema in rats

Treatment	Percentage Inhibition of paw edema		
	1hr	2hr	3hr
Inflammatory control	-	-	-
Celecoxib (10mg/kg)	19.12±0.96	43.14±0.96	53.95±1.03
F_1(200mg/kg)	9.62±1.05	17.54±0.93	34.41±1.16
F_2(200mg/kg)	15.05±0.89	33.46±1.09	44.09±1.01**
F_3(200mg/kg)	9.67±1.07	29.03±0.92	41.72±0.96**
F_4(200mg/kg)	8.60±0.96	27.19±1.01	35.71±1.06

Values are expressed as mean ± SD; n=6 rats per group.One way ANOVA followed by Dunnet's Multiple Comparison test; when compared with standard control **p<0.01

Table 7: **Levels of Inflammatory cytokines in Wistar rats**

Treated Groups	Dose (mg/kg)	Anti-inflammatory cytokines (pg/ml)		Pro-inflammatory cytokines(pg/ml)		
		IL-4	IL-10	TNF-α	IL-6	IL-8
Normal Control	1ml vehicle (2% tween80)	32.48	13.34	121.09	10.32	13.84
Celecoxib	10mg/kg	45.07	33.05	9.03	11.05	8.01
Inflammat-ory control	1% carrageenan	12.5	18.62	67.05	77.12	71.31
F_1	200mg/kg	22.5	22.09	13.14	13.01	11.12
F_2	200mg/kg	29.01	41.03	11.29	12.01	10.15
F_3	200mg/kg	23.73	24.05	10.18	13.12	15.17
F_4	200mg/kg	19.32	21.74	15.94	17.05	18.12

(n=3 rats per group, Tests were done in triplicate)

Figure 1: TLC of F_1

Figure 2: TLC of F_2

Figure 3: TLC of F_3

Figure 4: TLC of F_4

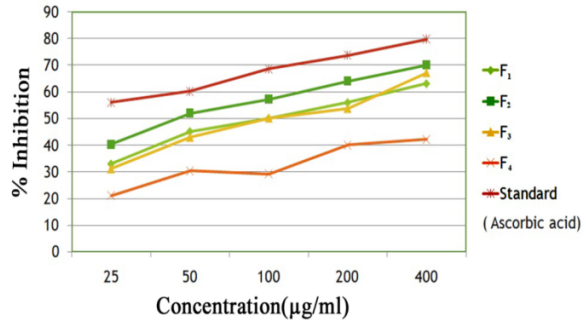

Figure 5: Comparative effect of the four fractions of methanolic leaf extract and Ascorbic acid on DPPH assay

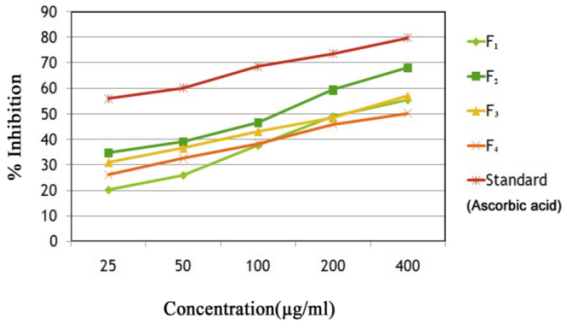

Figure 6: Comparative effect of four fractions of methanolic leaf extract and Ascorbic acid on H_2O_2 assay

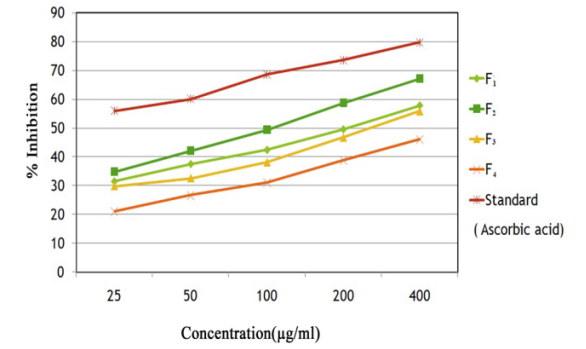

Figure 7: Comparative effect of four fractions of methanolic leaf extract and Ascorbic acid on Nitric oxide assay

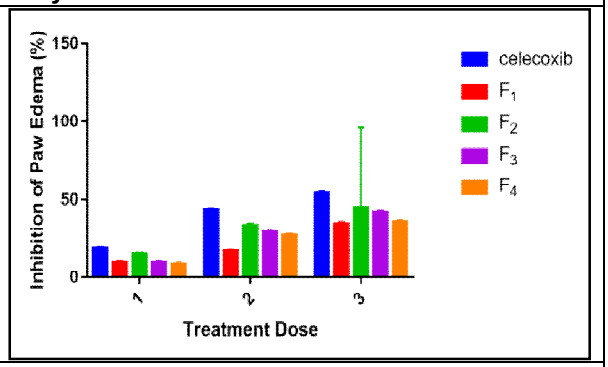

Figure 8: Graphical presentation of the inhibition of paw edema in rats by the four fractions of methanolic leaf extract

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RESEARCH ARTICLE

Eminence Assessment of Ground Water for Trace Metals: Madurai South Taluk, Madurai District

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ABSTRACT

The investigator has made an attempt to study the levels of heavy metals in 10 bore holes and wells located in various agricultural villages in and around Madurai South Taluk in Madurai district. Zinc (Zn), Copper (Cu), Chromium (Cr), Iron (Fe), Arsenic (As) and Lead (Pb) in groundwater concentrations were analyzed by Atomic absorption spectrometer. The results were compared with drinking water quality recommended by the Bureau of Indian Standards (BIS). This study shows that the Cu, Fe and Pb metals in a few places without the permissible level. Therefore this study also provides appropriate recommendations to prevent health risks caused by the impact of excess heavy metals.

Keywords: Heavy metals, Pollution, Groundwater, Water quality assessment, Drinking Water

INTRODUCTION

Water is an essential source of vitality for all living things. It is the most important and essential component of all animals, plants and other organisms and the key to the survival of mankind in the biosphere [1]. There are anaerobic organisms that can live without oxygen. But no creature can survive without water at any time. It is a universal solvent and as a solvent it provides ionic balance and nutrients, supporting all kinds of organisms. It is commonly found from two major sources natural, fresh surface water, lakes, rivers, and ground water. Ground water is found in well water and bore well [2].

Safe and good quality drinking water is the basis for human health. Water provides some essential elements, but when polluted it may dangerous to human health and cause disease such as various cancers, cardiovascular disease, neurological disease etc [3]. Groundwater is used for domestic, agricultural and industrial purposes in most parts of

the world. Human activities such as agriculture and domestic uses release large amounts of pollutants into water bodies. Thus environmental pollutants are growing, which is of great concern to local users [4].

Heavy metals were found to be one of the most dangerous to organisms and to increase the food chain due to their toxicity [5]. It causes great toxicity in humans such as damaged cardiovascular tract, kidneys, liver, lungs and bones. Metals from food intake and environmental exposure eventually reach their target organs, such as the brain, liver, and kidneys. The function of the metal within the body is determined by its ability to transform these systems. Excess metals in the body are excreted through urine and feces or accumulate in various tissues. These metals are toxic only at high concentrations [6]. It is not possible to completely avoid contact with toxic metals. However, it is our duty to detect the levels of highly toxic metals and prevent their effects [7]. In the present study, 10 bore hole and well water samples have been collected from Madurai South Taluk and various surrounding villages in Madurai district and analyzed various heavy metals like Zn, Cu, Mn, Cr, Fe, As, and Pb by atomic absorption spectrometer (Model Perkin Elmer A Analyst 100). The analyzed results are compared with the criteria set by the Bureau of Indian Standards (BIS) for ensuring the quality of drinking water.

SCOPE AND OBJECTIVES

Scope

Most of the chemical industries located in and around Madurai South Taluk in Madurai district. The number of Chemical, Industries Located around Madurai South Taluk discharge effluent from the Laboratories and industries, located around the Vaigai River at Madurai district. The other canals also discharge the polluted effluent in to the river without any treatment is increasing day by day. The absence of treatment plant to treat the industrial effluent and sewage water may lead to spoilage of the Vaigai River. One fine morning people will not be able to get good quality of drinking water from the ground water around the Vaigai River Bed. The environmental damage caused by water pollution by the discharge of chemical waste water and industrial effluent in Vaigai River has not been so for studied.

Objectives

- To study the Physico - Chemical parameters of the ground water present in the wells and bore well at Madurai District.
- To study the presence of heavy metals in Madurai South taluk villages and ground water.
- To study the impact of heavy metals on agriculture soil in and around of the Madurai South taluk villages and ground water.

MATERIAL AND METHODS

Water samples were collected in 5 liter polythene container from ten places in the farming villages around Madurai South Taluk in Madurai District. Before collecting the water sample, the polythene containers should be regularly soaked overnight in 10% nitric acid and rinsed in distilled water on the sample day. At the sample site, the bottles should be rinsed twice with water before filling. One ml of con. HNO_3 was added to each sample and the samples were then filtered using a 0.45µm milli bore membrane filter upon arrival in the laboratory. The samples were protected from sunlight and 1% dill in each polythene container to protect the groundwater from any contamination. HNO_3 added. Six Heavy metals such as Zn, Cu, Cr, Fe, As and Pb for each water sample were analyzed according to standard practice using a atomic absorption spectrophotometer [8,9].

RESULT AND DISCUSSION

The variation in the concentration of trace metal (Zn, Cu, Cr, Fe, As and Pb) in properly confiscated groundwater was evaluated (Table 1). The obtained results of the heavy metal analysis are reported in Table 3. A measurements and analysis shows that anthropological and weathering inputs are found to be important sources for heavy metals in groundwater. The concentrations of heavy metals were compared with drinking water standard quality prescribed by the BIS (Table 2).

Zinc

Zinc is very essential micronutrient in human beings and only at very high concentration it may cause harmful effects.[10] Zinc influences growth rate and bone development. The deficiency of zinc manifests itself by retardation of growth, anorexia, lesions of the skin and appendages, impaired development and function of reproductive organ. The values of zinc concentration obtained in this study, range from 0.272 to 0.482 ppm. Zinc content in all sampling sites, are within the permissible limit [11].

Copper

Copper is an essential substance for human life, but prolonged exposure to contaminated drinking water with copper can lead to anemia, liver and kidney disease [12]. High doses of copper are dangerous for children and those with certain metabolic disorders. On the other hand, lack of copper intake leads to anemia, growth retardation and blood circulation problems. In this study, the concentration of copper ranged from 0.031 to 0.069 ppm. The values are slightly higher compared to the permissible limit of copper (0.05 ppm) prescribed by BIS. High levels of copper in drinking water can cause vomiting, abdominal pain, nausea and diarrhea in humans. Copper can enter drinking water from copper pipes.

Chromium

Chromium is a naturally occurring element that is essential for both animal and human. That is, the synthesis of fat from glucose and also for oxidation of fat to carbon dioxide [14]. Excess amout of chromium can be toxic especially hexagonal form of chromium is very dangerous to humans. The presence of chromium in soaps and detergents used for washing and bathing may cause increase chromium level in water samples. The amount of chromium in the human body causes bronchial cancer in humans. In this current study area, the concentration of chromium content in groundwater ranges from 0.003 to 0.008 ppm. This study shows that all samples contain chromium levels within the allowable range recommended by the BIS.

Iron

Iron is the most commonly available metal on planet earth. Iron is chemically active and it forms two major series of chemical compounds namely bivalent Iron and trivalent Iron. Iron is very essential for living things [15]. It is found in meat, vegetables, potatoes and whole meal products. It is an essential part of hemoglobin which transports oxygen through our body. The deficiency of Iron causes anemia in human beings. In the present study, the concentration of Iron is ranged between 0.356 – 1.892 ppm. This result shows the level of iron above the maximum allowable limit recommended by the BIS. Excess of iron will also influence the presence of bacteria (Iron reducing) in fresh water. It affects target organs like liver, cardio vascular system and kidney.

Arsenic

One of the most dangerous trace elements found in drinking water is arsenic (As) being toxic and carcinogenic. Prolonged intake of arsenic at a concentration of 50 mg/l can lead to skin lesions. The current study found arsenic concentrations ranging from 0.001 to 0.008 ppm. It is clear from this study area that all samples have the limit allowed by the BIS [16].

Lead

Lead is a dangerous element; it can be harmful even in small amounts [17]. Lead contamination of groundwater may be due to industrial effluents, old plumbing, household sewage, phosphatic fertilizers and agricultural runoff containing human and animal emissions. The current study was recorded at different sites ranging from 0.041 to 0.982 ppm, which shows the level of lead above the maximum allowable range recommended by the BIS. High concentrations of lead in drinking water can harm the central nervous system and blood cells and cause brain damage.

CONCLUSION

Concentrations of heavy metals such as Zn, Cu, Cr, Fe, As and Pb were determined using atomic absorption spectroscopy. It shows that the groundwater samples examined have a high content of Cu, Fe and Pb in a few places. It is therefore recommended that appropriate water quality management is necessary to avoid contamination of metals such as Cu, Fe and Pb found to be highly concentrated in groundwater. Otherwise the ground water will become completely polluted and unfit for use for drinking and other purposes. People who depend on this water often suffer from health problems due to contaminated drinking water. Therefore domestic technologies must be followed to be suitable for water purpose.

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Table 1. Sampling Area in Madurai South Taluk surrounding villages in Madurai district

Sample No	Sampling Locations	Types of Well
MST1	Avaniapuram	Bore Well
MST2	Erkudi	Bore Well
MST3	Kallambal	Open Well
MST4	Kombadi	Bore Well
MST5	Moothankulam	Open Well
MST6	Nallur	Bore Well
MST7	Panaiyur	Open Well
MST8	Sambakudi	Open Well
MST9	Thoppur	Bore Well
MST10	Valayapatti	Bore Well

Table 2. Drinking water standards as per BIS

S.No	Parameter	Desirable (IS 10500)	Permissible (IS 10500)
1	Colour (Hazen Units)	5 Hz	25 hz
2	Odour	Unobjectionable	
3	pH	6.5 – 8.5	No relaxation
4	Total Dissolved Solid	500 mg/l	2000 mg/l
5	Hardness	300 mg/l	600 mg/l
6	Alkalinity	200 mg/l	600 mg/l
7	Zinc (Zn)	5 mg/l	15 mg/l
8	Copper (Cu)	0.05 mg/l	1.5 mg/l
9	Chromium (Cr)	0.05 mg/l	No relaxation
10	Iron (Fe)	0.3 mg/l	1.0 mg/l
11	Arsenic (As)	0.05 mg/l	No relaxation
12	Lead (Pd)	0.05 mg/l	No relaxation

Table 3 Heavy metal contents (ppm) in ground water

Sample No	Zn	Cu	Cr	Fe	As	Pb
MST1	0.286	0.091	0.003	0.356	0.001	0.041
MST2	0.293	0.087	0.003	0.892	0.003	0.048
MST3	0.282	0.132	0.005	1.321	0.007	0.446
MST4	0.325	0.072	0.008	1.832	0.002	0.362
MST5	0.272	0.089	0.007	1.634	0.009	0.052
MST6	0.291	0.102	0.003	0.976	0.003	0.982
MST7	0.425	0.031	0.004	0.874	0.001	0.624
MST8	0.482	0.058	0.006	0.782	0.003	0.421
MST9	0.394	0.077	0.005	1.184	0.008	0.098
MST10	0.279	0.065	0.008	1.004	0.001	0.894

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REVIEW ARTICLE

Review on Hard-Facing of Nickel Based Alloy on SS316l Composites

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ABSTRACT

The factors of wear resistance such as surface finish, hardness, strength, ductility, load, work hardening, lubrication, corrosion, speed, temperature are the significant factors of the wear resistance which has to be decreased or increased accordingly in order to get higher wear resistance. The most common wear mechanisms are abrasive wear, adhesive wear, cavitation, corrosive wear, erosive wear, fatigue, fretting wear.

Keywords: Hardd-facing, Nickel Alloy, Surface Engineering, Stainless Steel SS316L

INTRODUCTION

Wear is the progressive destruction which includes material loss that happens on the surface of a machine element due to the mating operating element. Almost all machines lose their stability and consistency due to wear and the potential of new advanced machines are reduced because of wear problems. Wear is classified based on the ways in which the resistance junctions are broken down, that is plastic displacement, destruction of surface film, elastic displacement, cutting, destruction of bulk material. If we consider wear as friction, is not a material property, it's a system response. Operational circumstances affect interface wear. Mistakenly it's generally assumed that high-friction interfaces exhibit high wear rates. But it is not a fact. As an example, interfaces with polymers and solid lubricants exhibit comparatively low friction and comparatively high wear, whereas ceramics exhibit moderate friction however extraordinarily low wear. It is unwanted in almost every device application like cams, gears, seals

and bearings. Mechanical components after a small amount of wear or as a result of rough surfaces need to be replaced. In well-made tribological systems, the removal of material may be a terribly slow process however it's steady and constant. The creation and transmission of wear debris, notably in machine applications wherever the clearances are tiny relative to the damage particle size. The factors of wear resistance such as surface finish, hardness, strength, ductility, load, work hardening, lubrication, corrosion, speed, temperature are the significant factors of the wear resistance which has to be decreased or increased accordingly in order to get higher wear resistance. The most common wear mechanisms are abrasive wear, adhesive wear, cavitation, corrosive wear, erosive wear, fatigue, fretting wear. Abrasive wear and adhesive wear modes are due to plastic contact between similar materials. At the point when surface failure is because of fatigue, the resultant wear is named fatigue wear. When the tribo-chemical response in the destructive media should be by material removal, the resultant wear is called corrosive wear. Wear control has ended up being a solid requirement for the high level and dependable innovation of things to come.

Wear Causes and Effects

Occurrence of wear depends on geometry of the surface, the rolling and sliding velocities, applied load, environmental condition, thermal and metallurgical properties, chemical properties of lubricant. On the opposite hand, wear is sensitive to the change of various system parameters such as stiffness, mass, material properties, shape, and environment. The material loss caused by the relative motion of bodies in contact with each other is termed as wear. Loss of efficiency in terms of mechanical performance is caused as a result of wear and occasionally causing damage to the working parts. The loss of materials from the contacting surface reduces the dimension of the element. This typically ends up in the exaggerated clearance between the moving elements and consequently leads to high noise, reduced efficiency, high vibration and system malfunction. If dynamic loading is concerned, the reduced element dimension might promote break, resulting in a catastrophic failure.

Surface Engineering

Surface designing incorporates all logical and specialized issues associated with the production of surface layers preceding end use or administration or during administration or on a substrate, with properties varying from those of the material which might be acquainted with the outside of the center as gas, liquid or solid. It additionally incorporates exploration of associated wonders and of potential and usable properties of surface layers, just as issues associated with layer design. Hence, surface designing envelops the absolute field of examination and specialized movement focused on the design, assembling, examination and use of surface layers, both innovation and for end use, with properties better than those of the center, It additionally incorporates exploration of associated marvels and of potential and usable properties of like mostly anti-corrosion, anti-fatigue, hostile to wear and enriching. The surface properties are improved, upgraded and constrained by surface designing. The information on material substrate structure is the fundamental state of creating layers on it. The properties of surface layers delivered are assessed by strategies utilized in surface designing, just as in examination and utilization of machines. These strategies are utilized dominatingly in regions, for example, tribology, corrosion, protection material strength, and so on The usage of surface layers or their creation over the span of administration has a place with the space of machine administration and considers, as a matter of first importance, issues of triboloy and corrosion protection.

Methods for Control of the Wear

Following are most widely used methods for the control of wear.

1. Lubrication technology
2. Materials substitution
3. Load reduction
4. Surface coating techniques
5. Removal of impact conditions
6. Hardfacing

Hard facing

Hard-facing, otherwise called "Hard-surfacing", is the utilization of develop of stores of particular compounds through welding interaction to oppose abrasion, corrosion, high temperature, or impact. Such a combination might be stored on a superficial level, an edge, or simply at point of a section subject to wear. Welding deposits can functionalize surfaces and recover segments broadening their service life. Welding is a critical innovation to satisfy these prerequisites and to apply hard-facing composites. A hard- faced part ought to be considered as an overlay, with the base material chose for strength and economy, and the hard-confronting material (which may be inadmissible just as excessively exorbitant for use in manufacturing the total part) chose for the particular wearing conditions to which the basic segments of the part will be oppressed in help. Hardfacing might be applied to another part during its creation, or it could be utilized to reestablish an exhausted surface. Hard-confronting expands the assistance life of a section and there by broaden the lifetime of machinery equipment efficiently. Figure 1 shows the hardfacing process.

Methods of Hard-facing

Welding is one of the hard-facing techniques where metal inert gas welding process was popular and effective in reducing the damage. This section gives details of welding process as a hard facing technique. The following are the various welding techniques used for hard facing. Metal inert gas welding is widely used for hard facing. Now a days use of robots in MIG welding adds flexibility to the process.

Literature Review

A good number of literatures are being reviewed in the area of hard facing to identify the research gap. This section briefly explains the work carried out by number of researchers till date to get an insight on material selection, sample preparation, uni-axial tensile test wear, hard facing, wear tests, abrasion test etc.

R.G Bayer [1] studied and reported on “damage to a surface because of relative movement as for another substance." For the reasons for this work wear will be characterized as the deficiency of material from a surface due to sliding along another surface. This definition is still very wide and incorporates a wide range of characterizations of wear. Two techniques for grouping wear are:

1. The conditions in which the wear happens and
2. The instrument by which the wear happens.

Conditions used to group wear incorporate whether there is a grease present, and regardless of whether there are hard, rough particles present. In the event that there is an oil present, it alluded to as greased up wear, else it is dry wear. On the off chance that there are grating particles causing wear, it is alluded to as abrasive wear, else it is called sliding wear.

S.C Lim et al [2] have grouped wear as per four systems: seizure, melt , oxidation, and plasticity. Seizure happens at high pressure factor when neighborhood severity contacts misshape until large areas of the surfaces are in touch and seize, Melt happens when the nearby temperature at the surface surpasses the dissolve temperature of the material and structures thin layer of fluid, oxidation wear happens when a flimsy layer of material on a superficial level oxidizes and wears away.

B. Venkatesh et al [3] have reported that the rise in volume of inorganic compound (carbide) improved the abrasion resistance. Wear resistance of materials are often improved by applying a hardfacing material on a substrate material and by heat treatment. Small structure plays a serious role on wear resistance additionally to the result of hardness in hard surfacing.

Tiago jose et al [4] have concluded in their study that " dilution impact on coating of the inconel 625 (Ni-based alloy), processed by plasma transfer arc hardfacing shows the sound coating were obtained on substrate and dilution increases with deposition current and the chemical composition of the substrate influenced the characteristics of coating measured by dilution and hardness.

Gopa chakraborty et al [5], have reported that it may be ended that dilution by primary solid solution stainless-steel substrate alters the microstructure of the hyper-eutectic alloy NiCr-C most conspicuously. Integrative changes because of dilution have an effect on the degree fraction and morphology of the precipitates, that is primarily answerable for the hardness and wear resistance of the deposits.

D. Kesavan et al [6], have reported that deposited coating experienced lesser wear loss when contrasted with the matured coatings for test led at room temperature. The deposited coating acted like the matured covering at high temperature tests (823k). The distinction in wear loss as for sliding distance of as kept and aged examples at room temperature is 1.2-1.5 occasions though at 823k it's almost 2.5 occasions. The overall corrosion resistance of the aged coating was lesser due to the chromium depletion in the medium.

M. Kamaraj et al [7], have carried out a study on plasma transferred arc welding process, Nickel based colmonoy 5 powder was successfully deposited on austenitic steel 316l substrate to a thickness of 4 to 5 mm. As compared to the substrate, an average of 2.5 fold increase in the hardness of the colmonoy 5 coating was observed. Increasing process temperature shows a decreased coefficient of friction and wear loss in coatings. Examination temperature plays major role in influencing wear loss of the coating than the sliding distance during testing.

Xiang Xu et al[8], in their study of inconel 625 coating obtained by laser cladding with wire, the strength of cladded is the highest (722 Mpa), followed by tensile strength of bonded area (706 Mpa) and tensile strength of substrate (624 Mpa). Whereas the elongation of cladded area is evidently lower than that of substrate. The yield strength of cladded area and bonded area is nearly same (456-457 Mpa), representing the similar yield property. Based on above literature survey all researchers emphasized on hardfacing is the suitable method for improving mechanical and wear properties of less expensive base metal by hardfacing a super alloy on the top of the base metal surface.

K. Gurumoorthy et al [9], in their study, temperature is the factor which strongly influences weight loss of the material. when the temperature is raised to 300 to 550^0 C, weight loss is nearly decreased to zero and reduced coefficient of friction is also observed while the experiment temperature is increased from room temperature to elevated temperature. Formation of oxide glaze during high temperature wear test results in a dramatic decrease in the wear rate in deed.

P.M. Anil et al [10], has worked on methodology that covers laboratory procedures for reciprocating wear of metals, ceramics, and different candidate wear-resistant materials employing a linear, mutual ball-on-flat geometry. The track of the relative motion between slippery surfaces reverses during a periodic fashion such the slippery happens back and forth and during a line. The principal quantities of interest be the damage volumes of the contacting ball and flat specimen materials; but, the Coefficient of friction might also be measured. The experiment can be carried out in both ways (with or without lubricant).

Stevenson et al [11], have concluded in their study that “wear rate increased linearly with normal load for low carbon steel specimens, up to maximum load. Based on the hardness of the rubber wheel the wear rate of the specimen increases. The coefficient of friction was found to be independent of applied load and sliding speed and also independent of the rubber hardness and rubber type.

H. Rojacz et al [12], has studied the 3-body wear behaviour of overlay welds of structural steel grades astm s355 and p92. Repair welding is capable of increasing the wear resistance of structural steel grades, which can reduce maintainace cost and downtime in high temperature abrasive wear application.

Naiju C D et al [13], have concluded in their study that coating thickness was maintained as 0.5,1 and 1.5 mm with 3 samples in each thickness value. Microhardness have revealed relatively extremely better value which are similar to conventional material made of inconel 625 and initial coefficient of friction was establish to be high which is around 0.2-0.3 over a period of time.

A.R Annappa et al[14], have carried out a study on sample prepared according to ASTM G65 to length and width of 75×25, thickness of 6mm. Alloy hardfacing on the plough tool material will increases the hardness of specimen by

retaining the toughness. Hear the factor which influences the wear rate statistically as well as physically is applied load (up to 85.22%).

Selection of Materials

The wear resistance of hardfaced surfaces depends on the weldability of the substrate and facing alloy as well as the conditions in which the welding process is carried out. of all the factors, the base metal has the best effect. Mechanical and technological properties of welded joints are straightforwardly subject to the synthetic piece (base metal and filler metal) and the construction of the weld metal and the heat-affected zone. The commonly used substrate metals for hardfacing includes stainless steels, mild steel, manganese steels, cast iron etc. A broad range of hardfacing materials can include cobalt-based alloys, nickel alloys, marternisitic and high-speed steels. In this work SS316L stainless steel is used as substrate and Inconel 625 nickel alloy is used as hardfacing material.

Stainless Steel SS316L

SS 316L is stronger at high temperature and exhibit better corrosion resistance, where L stands for low carbon content which minimizes deleterious carbide precipitations a result of welding. The table 1 shows chemical composition of stainless steel 316L material. It is a good choice for high stress situation and has better corrosion resistance due to presence of molybdenum. It is mainly effective in acidic environments. The presence of molybdenum gives better corrosion resistance properties compare to stainless steel 304. It has outstanding weldability by all standard fusion and resistance methods, both with and without filler metals. Machining must be done at low speed and constant feed rates, there is a chance of work hardens if machined too rapidly. The mechanical properties of SS316L are shown in Table 2.

Nickel Alloy (Inconel 625)

Inconel 625 alloy is utilized for its high strength, magnificent fabricability (including joining), and exceptional corrosion opposition. Administration temperatures range from cryogenic to 1800°F (982°C). Arrangement is displayed in Table 3. Strength of INCONEL composite 625 is gotten from the solidifying impact of molybdenum and niobium on its nickel-chromium matrix; hence precipitation solidifying treatments are not needed. This mix of components additionally is answerable for better obstruction than a wide scope of corrosive conditions of uncommon seriousness just as to high-temperature impacts like oxidation and carburization. In the atomic field, Inconel combination 625 might be utilized for reactor-center and control-bar segments in atomic water reactors. The material can be chosen on account of its high strength, incredible uniform corrosion obstruction, protection from stress breaking and phenomenal pitting resistance in 260-316°C water. Composite 625 is additionally being considered in cutting edge reactor ideas due to its high admissible design strength at raised temperatures, particularly between 649-760°C.

The key features of Inconel 625 include:

1. Excellent resistance to wear and corrosion.
2. Resistant to chloride ion stress corrosion cracking.
3. Resistance to caustics.

CONCLUSIONS

R.G Bayer concluded that if there is a lubricant present it is referred as lubricated wear otherwise it is a dry wear. Lim studied that wear are classified to 4 mechanisms: seizure, melt, oxidation & plasticity. Seizure occurs at high pressure, Melt happens when nearby temperature at surface surpasses the temperature of the material and Oxidation wear occurs when a thin layer of material on surface.Venkatsh have reported that wear resistance of material are often improved by applying a hardfacing material on a substract materials & by heat treatment.Tiago jose concluded that dilution impact on coating of the Inconel 625 (Ni-based alloy) processed by plasma transfer arc hardfacing shows sound coating wear obtained on substrate & dilution. Gopa chakroberty have reported that integrative

changes because of dilution have an effect on the degree faction & morphology of the precipitates. D. Kesavan has concluded that the deposited coating behaved similar to the aged coating at high temperature tests (823k). The overall corrosion resistance of the aged coating was lever due to the chromium depletion in the medium. M Kamaraj have studied that increasing the temperature shows a decreased co-efficient of friction & wear loss in coating. Examination temperature plays major role in influencing wear loss.

Xiang Xu have concluded that the area is evidently lower than that of substrate. All researchers emphasized on handfacing is the suitable method for improving mechanical & wear properties of less expensive base metal. K. Gurumoorthy explained in their study that temperature is the factor which strongly influences weight loss of the material. Formation of oxide glaze during high temperature wear test results in a dramatic decrease in the wear rate indeed. P.M Anil has studied that the tracks of the relative motion between slippery surfaces reverse during a periodic fashion. The principal quantities damage volumes of the contacting ball & flat specimen materials. A.N.J Stevenson has concluded that wear rate increased linearly with normal load for low carbon steel specimens upto maximum load. The co-efficient of friction was found to be independent of applied load. H. Rojocz has studied that wear behavior of overlay welds of the structural steel grades astm S355 & P92, which can reduce maintenance cost & downtime in high temperature abrasive wear application. Naiju C D have concluded that micro hardness have revealed relatively extremely better value which are similar to conventional material made of Inconel 625. A.R Annappa have concluded that alloy hardfacing on the plough tools material will increase the hardness of specimen by retraining the toughness.

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Table 1: Composition of SS316L

		C	Mn	Si	P	S	Cr	Mo	Ni	N
Grade 316L	Min	-	-	-	-	-	16.0	2.0	10.0	-
	Max	0.03	2.0	0.75	0.045	0.03	18.0	3.0	14.0	0.1

Table 2: Mechanical properties of SS316L

Grade	Tensile strength (MPa)	Yield strength (MPa)	Elongation (%)	Rockwell Hardness (HRB)
316L	485	170	40	95

Table 3: Composition of Inconel 625

Chemistry	Cr	Ni	Mo	Co	Ta	Al	Fe	C	Ti	Si	Mn	Ph	S
Min	20	58	8	-	3.15	-	-	-	-	-	-	-	-
Max	23	Bal	10	1	4.15	0.4	5	0.1	0.4	0.5	0.5	0.015	0.015

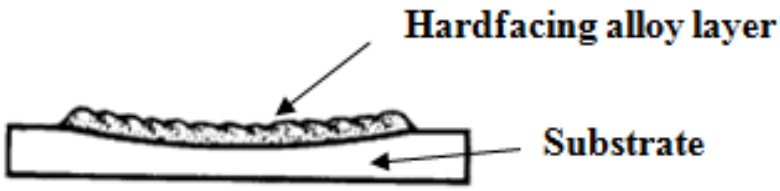

Fig. 1 Hard-facing technique

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RESEARCH ARTICLE

Policy Weaknesses Responsible for Loss of Agricultural Lands in Indian Growing Cities: Case Studies of Kolkata and Lucknow

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ABSTRACT

India's urban population was 377 million in 2011 and is expected to reach 600 million by 2031. Rapid expansion of cities in India is mostly taking place at the expense of fertile farmland. Annually, average 0.12 million hectares of farmland are eaten up by urban expansion in India. This paper aims to study the existing planning policies in India that are responsible for agricultural land loss in the development process. Planning policies are studied and compaired in detail for the developing cities of Pune and Bangalore with respect to regional plans and development plans of respective cities. The study reveals tremendous shift in planning policies over the period of time giving priority to development agenda for economic development of the region without giving deu consideration to preservation of farmlands that are coming under urbanization for all these growing cities. Many of the planning policies are common for all cities studied however few policies are seen to be in consideration to local conditions and political agenda. Study demand an immediate intervention towards planning weaknesses and change the few of the planning policies that can help preserving the farmlands that are coming under urbanization.

Keywords: Urban expansion, Farmland, Policy, Planning, Land Loss.

INTRODUCTION

The urban population of India was 377 million in 2011 and is expected to reach 600 million by 2031. Rapid expansion of cities in India is mostly taking place at the expense of fertile agricultural land. On average, 0.12 million hectares of agricultural land are consumed annually by urban expansion in India. [1] The expansion of urban agglomerations is the product of urban development and an increase in urban population. The first cause of urban expansion to the periphery is the growth of economic development programs, urban planning and industrialisation. Space is needed

for manufacturing, socio-economic infrastructure, connectivity and road networks which involve the reorganization and reconstruction of the space already inhabited by people. [2] The second reason for urban expansion to the periphery is mainly due to natural population growth, but rural-urban migration is contributing even more in many developing countries. [3], [4] [3],[4] In addition, cities continue to grow because of their popularity as a place to live and work, and as a center for trade, culture, education and the birthplace of technological innovation. [5], [6], [7], [8]. In the Indian context, horizontal urban expansion over peripheral villages takes place at the expense of productive and fertile agricultural land. [9] Expansion occupies farmland, displaces farmers and deprives farmers of agricultural employment. Eventually, this would lead to the impoverishment of displaced farmers. [2]

METHODOLOGY

This research work is focused on an interpretation of the material, field observations and interviews. Field study of four metro cities Pune, Banglore, Lucknow and Kolkotta, where horizontal urban growth over the past three decades has eaten up a significant number of periferal farmlands, followed by interviews with stakeholders. Content review, one case study and few interviews and discussions with affected farmers, planners, bureaucrats and developers are the basic elements of analysis of this research.

Case Studies

Study of Kolkata, West Bengal

Introduction of city

Kolkata, the administrative capital of the Eastern Indian state of West Bengal, is the 14th largest city in the world and was India's first metropolitan entity. Kolkata city and its surroundings area are named as Kolkata Metropolitan Area. All types of planning and development of this area are under the jurisdiction of Kolkata Metropolitan Development Authority (KMDA). Kolkata Metropolitan Area (KMA) is one of the largest agglomerations in the eastern India and also one of the oldest. KMA extends from Kalyani to Budge in the eastern bank and Bansberia to Uluberia in the western bank of the River Hooghly. It covers six districts in West Bengal, i.e., Kolkata, Howrah, Hooghly, North 24 Parganas, South 24 Parganas, and Nadia[1].

Urban expansion and farmland loss in Kolkata

The existing pattern of urbanization in this region is related very closely to the geographical distribution of natural resources and to the associated network of transport facilities and port which linked the concentrated industrial belt at the south of West Bengal. Thus due to the existence of great industrial system, Kolkata was act as the producer and distributor of goods and services, as the source of finance for the public and private enterprises, as the head quarter of variety of companies and organizations, as the center of advanced learning and modern medical facilities [3].

Population

The population of urban Kolkata increased from 1.5 million in 1901 to 14 million in 2011 as illustrated in Table below. The population of Kolkata was 1.5 million in 1901, 11 million in 1991 and a phenomenal 14 million in 2011 according to the census report. Due to enormous population pressure it has encroached into the back swamp and marshy land to the east, filling up extensive areas, especially in the Salt Lake and Rajarhat regions, in an unplanned manner. The urban population of Kolkata has grown tremendously in the last 4 decades. This fast rate of increase in urban population is mainly due to large-scale migration of people from rural and smaller towns to bigger cities in search of better employment opportunities and lifestyle [4].

Migration

After the independence of India, KMA has experienced a different type of in-migration pattern. Being situated near the Bangladesh border, this urban region remained the main destination for the refugees. Between 1946-1958 as much as about 31.32 million refugees came to West Bengal. Among them a considerable number entered to the present study area. Between 1958 and 1963 more than 50,000 and during the period 1964 – 1971 about 6 lakhs refugees came to this region [2].

Urban sprawl

Kolkata Metropolitan Area with the continuous urban tract on both the side of river Hugli variously called Greater Calcutta (GC), Calcutta Industrial Region (CIR), The Calcutta Conurbation (CC), or the Calcutta Metropolitan District (CMD) [3]. In the year 1951 Calcutta Industrial Region was accepted as an entity by the Census authorities, which included 36 towns over an area of 424.83 sq.km. The first planning effort towards urban development in West Bengal was started with the creation of Calcutta Metropolitan Planning Organization (CMPO) in 1960. Then for the purpose of integrated planning the Calcutta metropolitan district (CMD) which was established legally by the Resolution No.1833/IE-5/64 of Government of West Bengal in 1964, with an area of approximately 1269.09 sq.km [3].

Farmland loss

Urbanization and urban growth concentrate mainly on the peripheral areas, rural areas, and small town areas in the outskirt of the city. Population growths in urban areas are related to the spatial expansion of cities. Due to huge urbanization in the metropolitan city area and its resultant urban expansion, most of the vegetation area, agricultural land, and water bodies have been converted into the residential area, commercial area, or barren land area. It is observed that in 1990, the percentage of agricultural land is high in the Kolkata city. But percentage of cultivated land or agricultural land has been decreased very rapidly because of the rapid encroachment of the urban areas toward the rural areas of the Kolkata city [1].

Displaced farmers in Kolkata

The percentage of agricultural area is decreasing because of the encroachments of the urban areas to rural areas. Other than these reasons, because of the easy availability of cash money, most of the agricultural labor or cultivators in these areas want to engage in the secondary activities like grocery shops, car driving, etc. Adding to this, it has been found that percentage of non-availability of water supply is high among the rural areas of KMA. Piped water supply is very useful for the cultivation of crops. Good market facility is another criterion for the agricultural practices. It not only helps them to earn easy earnings of money but also those goods can export to the city for the daily needs of the people. Market facility is major factor behind the growth of the agricultural area. Hence due to shortage of basic facilities farmers are engaging in other activities [1].

Planning instruments to control farmland

Kolkata is one of the metropolitan cities in India with 15.89 million populations and scarcity of open land which determines the value of agricultural areas to the people. It means that as the urbanization rises more and more agricultural land is converted to non-agricultural uses, which lead to the reduction of agricultural production. To discourage this conversion the policy-makers should focus on this major issue. The planners and policy-makers of Kolkata city should make different planning strategies for the sustainable development of Kolkata city by preventing those agricultural tracts from the encroachments of the urban areas [1]. Land Use and development Control Act is being exercised under West Bengal Town & Country (Planning & Development) Act, 1979. The objective in this control exercise is to ensure that the vacant land including cultivable land, green and wasteland, water bodies, swamps and marshes does never become less than 33% of the total land.

Planning Policies in Kolkata

Land use policy

The Mamata Banerjee-led government ran hardcore opposition stand against setting up of SEZs in the state. The West Bengal government's hands off land policy and leaving the entire aspect land transaction for industry to the market sounds quite irrational and counter- production for industry. If the land transaction is left entirely on the market it would encourage the land mafias, which in turn would artificially jack up the land price and the project cost. Leaving the entire assignment of land transaction to the state would lead to Corruption among the politicians and bureaucrats. Hence, the task of land transaction should be left on a quasi-judicial body or a land commission set up in lines of the regulatory commissions. (Bengal's land & SEZ policy defies logic, says economist, 2013) In 2008, the Left Front government acquired 997 acres of land in Singur, 40km from Kolkata, under the Land Acquisition Act (LAA), 1894, for Tata Motors to build the Nano factory. If Tata Motors' had to individually bargain with 13,000 landowners for their erstwhile project at Singur, the ultimate project cost would have been much higher.

Zoning regulation

The West Bengal government has proposed lifting building and land conversion restrictions in a section of the 12,500 hectares of East Kolkata Wetlands (EKW). The move will kill the world's largest organic sewage management system and choke Kolkata. But environmental experts say the decision will harm the wetland already facing threats from encroachment and illegal construction. "There cannot be any area of 'no importance to wetlands' in EKW. It sounds like the government aims at sacrificing them for urbanization. It was their petition in the Calcutta high court in 1992 that resulted in the ban on land conversion and special regulations.

Master plan principles

Urban areas are the engines of the development of rural hinterlands in any region. Effective planning in the regional scale provides appropriate preference and promotion of industries and commercial activities. The urban agglomeration along both banks of the river Hooghly in Kolkata is designated as Kolkata Metropolitan Area (KMA). Several issues have come up in the development of the region.

Farmland protection policy

The Congress chief Mamata Banerjee may be willing to sacrifice the state's industrial prospects to "protect farmland" in Singur, but farmers riding the Nano wave are not hesitating to sell off their plots if the price is high enough. The land prices are rising due to the Tata project and the farmers are given four to five times more than the compensation package. In desire for money farmers are also willing giving up the land. According to a land deal document issued by the Singur ADSR, a two-acre plot of farmland was sold on August 27 at Jhakarimouza for Rs 32.51 lakh - more than Rs. 16 lakhs per acre - though it is two to three kilometers from the project site and does not even have a pucca road. Plots closer to the Nano plant and the Durgapur Expressway are going for thrice as much. Economist said this was to be expected when a project of the magnitude of Nano takes shape in an area where there has been little development. In such a situation, the land is usually bought by investors, speculators and industrialists. The state offered a compensation package of Rs 8-12 lakh, depending on the character of land during the acquisition in 2006. But over the last two years, land price in Singur has jumped 500- 700 %. (Mukherji)

Farmer's right policy

In spite of being ruled for over four decades by governments considered to be pro-farmer, the administration has failed to implement government assistance schemes for farmers. West Bengal Chief Minister Mamata Banerjee in January announced two crucial schemes for farmers. First, she announced a 100% premium for crop insurance in a bid to ensure farmers don't become indebted either to banks or private lenders. The second was the Krishak Bandhu scheme through which the state government provides Rs 5,000 per acre twice a year to farmers between the age group 18 and 60 years.

Land acquisition and compensation policy

In May 2006, the then West Bengal chief minister, Buddhadeb Bhattacharya, and the then Tata group chief, Ratan Tata, announced that the Nano project would come up in the state. In 2008, the Left Front government acquired 997 acres of land in Singur, 40km from Kolkata, under the Land Acquisition Act (LAA), 1894, for Tata Motors to build the Nano factory. It became controversial because it was prime arable land that was forcibly acquired by the West Bengal government.

Farmer eviction and resettlement policy

Urban development-induced displacement and resettlement, and its impact on the quality of life of the affected population over the longer term. Effects are characterized by multiple losses, including loss of homes, livelihoods and community resources, leading to even greater impoverishment after resettlement. The need to look at both the households that have been uprooted and resettled as well as households that remained in place, in order to understand the consequences of the impacts more fully. Starting with living conditions, the resurvey indicates continuing dissatisfaction with the small size of the housing units.

Agriculture policy

Farming in West Bengal is individual-driven and unorganized, with the average size of holding being 0.82 ha, much lower than the national average of 1.33 ha. Therefore, individual farmers, with very small marketable surplus of produce, have to pay market price for all farm inputs and other basic utilities and consumable items. There is, therefore, a need to organize a vastly unorganized farming community in such a way as to help them to gain from the market economy. Smallholders are competitive in high value agricultural activities, because of the availability of family labor and their ability to compete in local markets. However, as production and marketing systems evolve, support to smallholders to provide efficient input services, links to output markets and risk mitigation measures will be important, if they are to provide higher value products. (Singh, 2014)

Study of Lucknow: Uttar Pradesh

Introduction of city

Lucknow, the capital city of Uttar Pradesh enjoys a central position in the state and situated in the central part of India. The urban agglomeration consists of Lucknow Municipal Corporation and the Lucknow Cantonment[1]. The city lies on the bank of the river Gomti, a left bank tributary of river Ganga. It splits the city into two unequal halves, the Trans-Gomati and Cis-Gomati regions. Lucknow has revolutionized from a small population center in 1972 to a big urbanized city in 2016 having varied economic, physical and political feature. It is the 11th most populous city of India and emerging as one of the most rapidly growing urban cities of Central India [2].

Urban expansion and farmland loss in Lucknow

An urban expansion is a very natural phenomenon for any urban Centre which is driven to various push and pull factors occurring within the city. Lucknow has witnessed a great amount of urban expansion in the last few decades. Urban expansions have various contributing factors that lead to this process. The various factors are Demographic, Physical/Spatial covering Land and infrastructure aspects, Social and Environmental, Economic and Governance related.[4]

Population

The population of Lucknow has seen a considerable rise since 1971. The population of Lucknow City was 8.13 lakhs in 1971 and has risen to 28.80 lakhs in 2011. Being the capital city of the state and administrative headquarters of many districts and division, the most of the population in the nearby districts are migrated to the capital for a better lifestyle, job, and academic facilities [3].

Migration

Migration is considered yet another major reason for population influx in the city which in turn arises the need/demand for housing. Migration into Lucknow accounts for 36% increase in population over the last decade. Of the 5.76- lakh people added to the LUA during 1991-2001, about 2 lakhs were migrants. In comparison, the natural growth was 3.68 lakh [5].

Urban sprawl

The two major problems with urbanization trend are its growing rate and the area it swallows to accommodate the urban. The urban geographical area in 1971 was reported 80.00 Sq. Km which has increased to 212.24 Sq. Km in 2001 in the period of 30 years. After 1971 urban sprawl started up and in 10 years, it has increased 130.11 Sq.km (1981), though it witnessed slow urban sprawl in this decade.

Farmland loss

Lucknow is growing at unprecedented rates, creating extensive urban landscapes. Many of the agriculture and horticulture fields, wetlands, and forests that formed the Awadh's Capital of 1900 have been transformed during the past 100 years into human settlements [6]. In whole Uttar Pradesh out of 70 districts (2001) in Lucknow district the occupation of land put to non-agricultural uses is among the highest both in rural and urban areas. Lucknow being the capital city has a continuously fast process of occupying the neighboring fertile land of the villages. The result is during last 13 years, i.e. between 1994-95 and 2007-08, the growth rate of land put to non-agricultural uses in neighboring rural areas of Lucknow metropolis was recorded 45.1 per cent [7]. There is limited understanding about the correlation between the two primary aspects – the urban sprawl and agriculture land. The loss of agriculture land over the year in correlation to the urban area has been recorded in the table below.

Displaced farmers in Lucknow

The expansion of cities is taking place on commercially viable areas ignoring the importance of environment and land meant for cultivation purposes. The farmers on urban fringes are compelled and lured to sell their land to urban people and they lose their centuries old traditional livelihood from farming forever. Most of the households have almost shifted their dependence on non-farm activities, as the remaining agricultural land has become nonproductive and it is in the process of selling with the hope of better prices for urbanization which is imposed. Lands purchased by Government by force are paid only less than Rs.50,000/- per bigha when private parties are paying in millions of rupees [7].

Planning instruments to control farmland

UP has got diverted huge tracts of agricultural land for development projects in last few years, for construction of roads, bridges and expressways. The first-ever environment policy of UP, would make diversion of agricultural land for non-agricultural use difficult. It would also make it mandatory to compensate for the loss of agricultural land, in case it is used for any other purpose, by making fallow and degraded land agriculturally productive. Expansion of existing cities and development of new cities, if any, should be done on less productive land, says the draft policy. The draft policy emphasizes on conservation of land, water, air, forest, wildlife, bio-diversity, soil and wetlands in the state. It says the environmental loss should be economically assessed and the amount spent on restoring and conserving environment [8].

Policies for Lucknow, Uttar Pradesh

Land use policy

The GoUP, with a view to mitigate the housing problems in the urban areas and to promote planned development of the city, formulated a policy (November 2003) to invite private developers with minimum investment. This policy was called Hi-tech Township Policy and was amended from time to time. GoUP selected (2005-06 to 2014-15) three developers11 to develop Hi-tech Township on 8,014.03 acre of land. As per terms and conditions of the Memorandum of Understanding (MoU) (November 2005) with the developer, if the site selected by the developer

falls outside the limits of development area of Master Plan 2021, it shall be brought within development area and if such land needed conversion of land use, land use conversion charges as prescribed by GoUP shall be payable by the developer.

Zoning regulation

In a decision that will help real estate developers acquire agricultural land, the Uttar Pradesh government cleared a decision to allow urban land fragmentation in the state. With this, real estate developers will now be allowed to convert pockets of agricultural land to use for residential or industrial purposes. The decision to dilute the Zamindari Abolition and Land Reforms Act goes against an earlier diktat by the SP government in which officials of the revenue board and urban development department were directed to disallow the rampant acquisition of fertile agricultural land by the builder and developer lobby. According to the land management norms, the urban land fragmentation must be done in keeping with the zonal master plans for a region and not on a short-term basis. The zonal master Plan is based on the watershed approach. It includes governance in the area of wildlife, forest, irrigation, energy, public, road infrastructure and public health and sanitation. The Uttar Pradesh government cleared a decision to allow urban land fragmentation clause in the state. Under urban land fragmentation clause of Uttar Pradesh Consolidation of Holdings Act, 1953 developers will now be able to buy partial pockets of fertile land from farmers, submit their proposals to, and get approvals for their blueprints from the Zila panchayat. (T. T. India 2014).

Master plan principles

Lucknow Development Authority (LDA) has announced to develop a new city master plan taking into consideration facilities which the state capital would require till 2031. The current plan highlights the city planning till 2021. The new plan will cover housing and transport facilities, road connectivity, green cover, etc. LDA announced to include the city's extended areas under the master plan 2031. This would empower LDA to approve maps in these areas. Currently, the sanction is done by zila panchayats. LDA says that the power to sanction map is vested with it according to 'UP Urban Planning and Development Act 1973'.

Farmland protection policy

The UP-Revenue Code (Amendment) Bill, 2019, replacing an ordinance amending the Uttar Pradesh Revenue Code has been passed recently, and it has streamlined the process of converting agricultural land to non-agricultural land through an amendment to Section 80. As per the ordinance, an owner of agricultural land in the state can convert it for industrial, commercial, or residential use based on the approvals received on their applications for the same purpose. Amongst other uses, the land can also be leased by the owner for either agricultural purposes or for setting up solar energy projects in the state. (RANGANATH 2019)

Farmer's right policy

The Uttar Pradesh Zamindari Abolition and Land Reforms Act of 1950 prohibited leasing of land except in special circumstances, such as leasing by widows, minors, or persons with a physical infirmity. But rather than protect tenant farmers from exploitation, subsequent research has revealed that leasing prohibitions have had overwhelmingly negative effects on agricultural growth, social equity and investment in rural development. Importantly, restrictions on land leasing make it much more difficult for landless and land-poor marginal farmers to access land. This pushes many farmers to seek land through informal leases that heighten their land insecurity. Many informal tenants reported that they are typically not able to access credit or government input subsidies and cannot demand the minimum support price when they sell their crop. And if the crop fails, they do not have the benefit of crop insurance. All such benefits usually go to the person who owns land, and these are typically not passed to the tenant.

Land acquisition and compensation policy

Delay in acquisition of land

The Infrastructure and Industrial Development Department of Uttar Pradesh did not prescribe guidelines for time bound acquisition of land for industrial use in pursuance of the Infrastructure and Industrial Investment Policy 2012. This has resulted in delay in acquisition of land by the authorities. Lucknow Industrial Development Authority (LIDA) had four land acquisition cases in Natkur, Miranpur Pinwat, Banthra Sikandarpur and Kurauni villages involving an area of 1,985.14 acres. However, it failed in finalizing the Master Plan for its notified area even after ten years of its constitution, resulting in non-achievement of its objective of industrial development of the area. LIDA could not acquire land as the acquisition of land in villages was quashed by Hon'ble High Court due to delay in issuance of notification u/s 6/17 by the Department and non- preparation of Master Plan. This has resulted in loss of` 7.06 crore on account of deduction of acquisition charges by Special Land Acquisition Officer (SLAO). Moreover, an amount of ` 6.45 crore was blocked in resumption of Gram Sabha land due to delay in survey and planning for its utilization. In reply, LIDA stated that notification under section 4/17 and 6/17 was issued by the Department for acquisition for planned industrial development. (Authority 2015)

Farmer eviction and resettlement policy

A study conducted for a research in 2011 on the basis of primary data to analyze the quantum of land lost by the farmers and the amount of compensation paid to them in industrial and housing projects in Ghaziabad and Lucknow districts of Uttar Pradesh. The Land Acquisition Act, 1864 and the Rehabilitation and Resettlement Policy of the Government of Uttar Pradesh, pronounced on April 30, 2010 have been examined to find out to what extent the new policy of the state would resolve the contentious issue of land acquisition and compensation payment. The findings of this study indicated that farmers were looser in the past from all angles, despite their protests and agitations; the State had shown a cold response to their genuine demands. Households expressed that compensation was insufficient and did not replace their previous income. They observed that the State had deprived them by making payment of compensation at lower rates than what should had been owing to high fertility of their land. The impact of land acquisition both in the case of industrial and housing projects indicated that many effected farmers, more than 40 per cent could not get full compensation after several years of their land acquisition due to one or other reasons. (Fahimuddin, 2011)

Agriculture policy

The State Agriculture Policy 2005 for Uttar Pradesh envisaged 4% growth rate in the agriculture sector. To achieve this, the Agriculture Policy revolved around implementation of activities based on seven thrust areas, called Sapt Kranti viz. extension, irrigation and water management, soil health and fertility, seed management, marketing, research and agriculture diversification. In Eleventh Five-year plan, the state could achieve only 3.0% growth against the planned 4.0% for agriculture sector. Since the commencement of the existing agriculture policy, there has been a drastic change in agricultural landscape of the state. (The Energy and Resources Institute, n.d.)

SURVEYS AND INTERVIEWS

Farmers, planners, bureaucrats, and politicians were interviewed using semi structured questions in the cities of Kolkota and Lucknow. For the interviews, random samplings were chosen to collect generic information and responses. The stakeholders who are directly involved or affected by agricultural land loss and its consequences have been identified. The city of Kolkata enlists the assistance of local architecture students to overcome the language barrier when conducting farmer interviews. It was difficult to identify the farmers who had been impacted by the loss of agricultural land. Local people's support, on the other hand, has been successful in all of the cities.

Summary of the responses obtained in the interviews are as follows

Inferences

- Survey clearly shows that farmers are economically as well as socially affected by loss of land.
- The above number shows actual difference between the decided compensation versus received compensation.
- Agriculture land is lifelong source of income for farmers. Whereas the compensation received against the land has no long financial benefit the farmers.
- Irony of the land loss is that the farmers once who had his own piece of land and a good income has to work at construction sites and industries to sustain at low wages.
- Farmers is the key stalk-holder hence his involvement in the land acquisition process as well as in deciding the compensation is important.

Cumulative planners' responses through interviews in Pune and Banglore

Inferences

- Agriculture land use should be clearly identified as separate land use rather than demarcating green zone.
- Land is main source of livelihood for farmers hence proper consideration should be taken while displacement.
- Should have bottoms-up approach while formulating the policies for protecting the agriculture land.
- Productivity of Agriculture land and future yield is clearly not considered while deciding resettlement and compensation.
- Planners should develop new strategies for sustainable growth of city.
- Planning should also consider the social repercussions of the land loss on the farmers.

Cumulative beuracrats' responses through interviews in Pune and Banglore

Inferences

- Farmland loss has economic as well as social effect on the farmers hence bureaucrats should show support to them.
- In case of compensation bureaucrats should form proper committee for deciding the compensations which has long-term benefit.
- Bureaucrats should form proper committee for necessity of resettlement but also monitor post- resettlement condition.
- Bureaucrats should not consider the growth of city on the cost of farmers and their livelihood.
- Bureaucrats have major role in policy formation hence regulating conversion of agriculture land to NA by drawing firm policies.

Cumulative politicians' responses through interviews in Pune and Banglore

Inferences

- Farmland loss may result in an imbalance between food producers and food consumers, resulting in food security issues.
- The party's core idea should be to learn from past mistakes and develop new agendas to support farmers.
- Farmers are a pillar of the nation's economy, so prioritising their needs is critical in the current situation.
- Creating new growth strategies in collaboration with all stakeholder groups, such as farmers, planners, and bureaucrats.
- Developing new policies or redefining existing ones for agricultural land conservation.
- All stalk holders should work together to protect farmland and farmers.

RESULTS AND CONCLUSIONS

This paper examines the topic and conducts case studies in Pune and Bangalore to better understand why planning approaches fail when it comes to implementing urban development strategies that protect farmland and farmers' livelihoods. While urban expansion is considered to be pursued in the planning of the Regional Plan and Development Plan, in accordance with the legal requirements of the subsequent Regional and Town Planning Acts applicable from state to state, there was no security of agricultural land due to weak policies and unidirectional land implementation. Farmers whose land is purchased as part of the planning process are compensated in cash, transfer of development rights (TDR), or established land unrelated to their current occupations. There are no attempts to resettle displaced people in order for them to live and sustain their agricultural and livelihoods. During the planning process, the needs of those rural groups that are not included in a new socioeconomic urban context are not taken into account. Due to a lack of sensitive planning and implementation policies, farming communities are left without potential opportunities, resulting in poverty. Changes in land use that are not properly planned for result in hazardous environmental conditions and a threat to food security. The study strongly suggests that there is an urgent need to change existing planning policies, land use change policies, and zoning policies to protect farmlands and farming communities' livelihoods.

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Table-1. Population census and city area correlation in KMA, Source: (S. K. Nath, 2015) (Saha, 2015) (Mitra, 2016).

Year	Population	Area under city (sq.km)	Population Growth rate (%)
1960	5983669	1269.09	28.14
1970	7420300	1482	24.01
1980	9194081	1380.75	23.90
1990	11021918	1785.04	19.88
2000	13205697	1851.41	19.81
2010	14112636	1886.67	7.6
2021*	15,845,219	1946.67	

Table 2: Agriculture Land use in Kolkata city (1980-2021)Source: (Majumdar, January 2020)

Agriculture Land use in Kolkata city (1980-2021)		
Year	**Area under agriculture land use (sq.km)**	**Area under agriculture land use (%)**
1980	104.54	7.89
1990	99.60	5.58
2000	72.01	3.89
2010	61.5	3.26

Table 3: Agriculture land loss over the year in KMA Source: (Saha, 2015)

Agriculture land loss over the year		
Year	**Area under city(sq.km)**	**Farmland Land loss**
1960	1269.09	
1970	1482.0	212.91
1980	1325.0	-157.0
1990	1785.04	460.04
2000	1851.41	66.37
2010	1886.67	35.26
2021*	1946.67	60.00

Table 1: Number Working Population as Cultivators in KMA Source: (CENSUS OF INDIA 1981, 1988) (India, 2011)[6, 7].

Number Working Population as Cultivators		
Year	**Number of Cultivators**	**Number of Displaced farmers**
1980	37236	-
1990	28216	9020
2000	23109	5107
2010	9009	14100

Table 5: Population census and city area correlation in Lucknow Source: (City Development Plan,Lucknow, 2006) (Dutta, 2012)(Kumari, 2015)

Year	Population	Area under city (sq.km)	Density/sq.km.
1950	496177	48	10337.0
1960	655673	79.16	8282.9
1970	813982	80.00	10174.8
1980	1007604	130.11	7744.2
1990	1669204	159.00	10498.1
2000	2245509	212.24	10580.0
2010	2880108	304.00	9474.0
2021*	4500000	414.34	10860.6

Table 6: Composition of Growth during 1991-2001in Lucknow

Components of Urban Growth	Population	Per Cent Distribution
Total increase	576305	100.00
Natural increase	368998	64%
Increase due to migration	207307	36%

Table 7: Agriculture Land use in Lucknow city (1980-2021)Source: (2011) (Dutta, 2012)

Agriculture Land use in Lucknow city (1980-2021)	
Year	**Area under agriculture land use (sq.km)**
1980	80.01
1990	100.83
2000	87.37
2010	35.41
2021*	21.17

Table 2: Agriculture land loss over the year in in Lucknow Source: (City Development Plan,Lucknow, 2006)

Agriculture land loss over the year		
Year	**Area under city(sq.km)**	**Farmland Land loss**
1950	48	
1960	79.16	31.16
1970	80.00	0.84
1980	130.11	50.11
1990	159.00	28.89
2000	212.24	53.24
2010	304.00	91.76
2021*	414.34	110.34

Table 3: Number Working Population as Cultivators in Lucknow Source: (City Development Plan,Lucknow, 2006)

Number Working Population as Cultivators		
Year	**Number of Cultivators**	**Number of Displaced farmers**
1980	8706	-
1990	32208	-23502
2000	12783	19425
2010	9194	3589
2021*	6750	2444

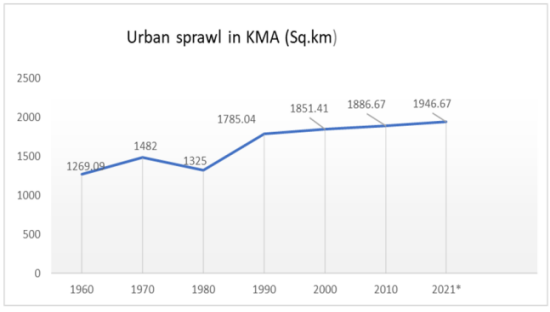

Figure 1: Urban sprawl in KMA (Sq.km), Source: (Saha, 2015) (Mitra, 2016)

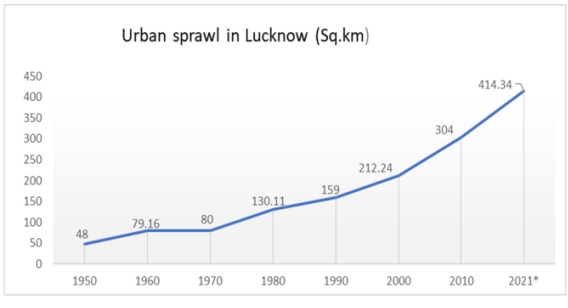

Figure 2: Urban sprawl in Lucknow (Sq.km), Source: (City Development Plan,Lucknow, 2006)

Figure 3. Cumulative farmers' responses through interviews in Pune and Banglore

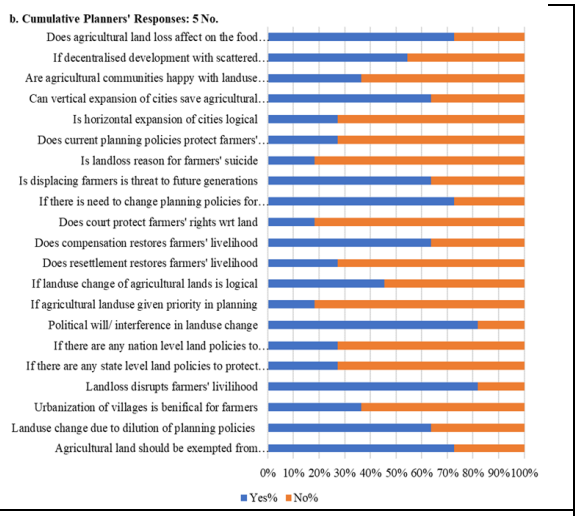

Figure 4. Cumulative planners' responses through interviews in Pune and Banglore

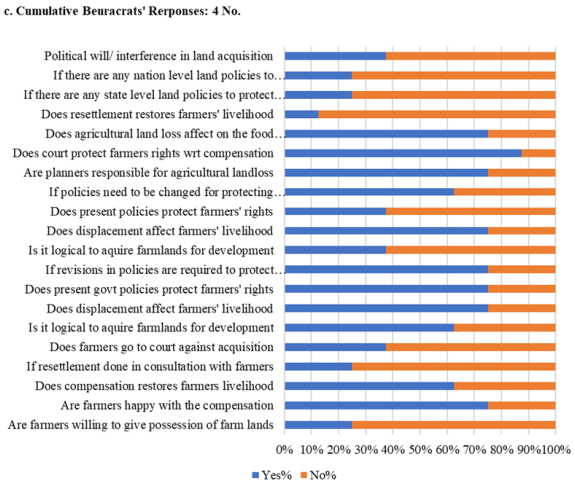

Figure 5. Cumulative beuracrats' responses through interviews in Pune and Banglore

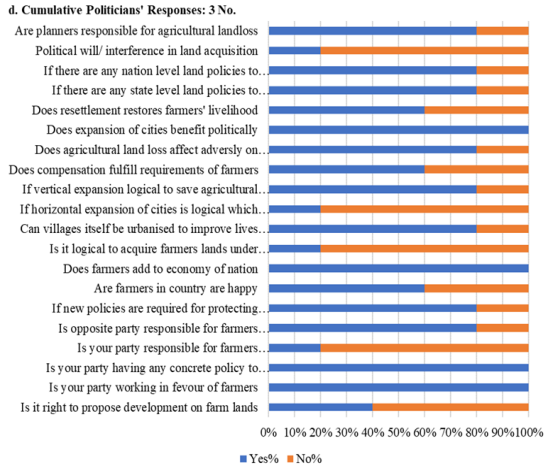

Figure 6. Cumulative politicians' responses through interviews in Pune and Banglore

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RESEARCH ARTICLE

Seasonal Prevalence of *Aedes aegypti* in Urban and Industrial Areas of Udaipur District, Rajasthan

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ABSTRACT

Udaipur district also called the city of lakes of Rajasthan. There is chance of dengue infection by the *Aedes aegypti* during the after rain fall in the urban and industrial areas of the Udaipur district. The seasonal figure of egg laying movement and profusion breeding sites of dengue vector surveyed in urban and industrial areas of the district. During January 2018 to December 2018, we found a total of 645 ovitraps and 4407 wet containers. The survey showed high percentages of positive ovitraps and positive breeding sites for dengue vector among greater abundance in the after rainfall (post monsoon seasons). The preference of breeding and ovitraps ratio during all seasons was highest for industrial areas. The percentage of breeding sites and positive ovitraps are high in post monsoon season although we observed to the percentage of the different seasons. In both the areas maximum breeding and ovitraps density prevailed in the months of September (26.08% and 58.33% breeding sites 33.68% and 63.32%). The maximum breeding sites and oviposition density was noticed during August to October during rainy season. In May and June the decline in breeding and oviposition index is noticed. From December to February the larval index was broadly low.

Keywords: *Aedes aegypti,* seasonal prevalence, breeding sites, urban, industrial area, Udaipur

INTRODUCTION

Dengue occurs in spreading countries of the tropics with evaluated 2.5 billion people consisting in endemic areas (World health organization [WHO] 2007). Mainly two species of dengue mosquitoes *Aedes aegypti* (L) and *Aedes albopictus* (Skuse) are treated as dengue vectors. *Aedes aegypti* is a principal vectors in urban areas and day biting mosquito, *Aedes aegypti* is further prevalent human dwellings (Gouled *et al.,* 1968). The first spreading of diagnostic

dengue same illness was reported in Chennai in 1780 and the first virologically showed epidemic of dengue fever in India appeared in Calcutta and Eastern coast of India in 1963-1964(Sarkar *et al.,* 1964, Chattergee *et al.,* 1965; Carey *et al.,* 1966). The most favorable temperature for *Aedes aegypti* larva is 28°C. Over this the frequency of development is high and below 18°C the increase gets extend the duration (Christophers et al., 1960). Above 36°C larva progress is not more proper (Bar-Zeev *et al.,* 1958). Maximum hot and dry season may destroy almost of the eggs (Gubler *et al.,* 1988). Development of *Aedes aegypti* population tropical and subtropical areas appear all year round and their quantity can either related with rainfall controls (Moore *et al.,* 1978; Chadee *et al.,* 1991, 1992; kalra *et al.,* 1997; Micieli & Campos, 2003) or not (Sheppard *et al.,*1969; Barrera *et al.,* 1997). The objective of this survey was telling mosquito urban and industrial habitats to determine larval abundance, density and habitat types of Udaipur city. The current survey was therefore organized to determine the container breeding favorite of mosquitoes by larval study in the Udaipur city (Rajasthan). The other objective of the survey was to notice in case *Aedes aegypti* population has confirmed here in great density and also to see the effect of temperature and rainfall on the density of dengue mosquitoes. *Aedes aegypti* to access its seasonal breeding markings in study area.

MATERIALS AND METHOD

Udaipur is located in state of Rajasthan in India. Udaipur is located at 24'58°N; 73'68°E. It has an average elevation of 598 meters (1961 feet) and total area 64 km². Udaipur is bordered by Rajasamand district in North, Chittorgarh and Pratapgarh district on the East Banswara district in Southeast, Dungarpur in South and Gujarat is southeast direction. Udaipur district is mainly hilly. The Western area of the district is drained the Sabarmati River, Which originates in the Aravali range of Udaipur district flows into Gujarat. The Northern area of the district is drained by tributaries of the Banas River including the Ahar River which flows through the city of Udaipur. The Southern and Central area of the district is drained by tributaries of the Mahi River, entering the Som and Gomti. The sites included under municipality are held as urban sites which are particularly populated with speedy urbanization and industrialization. The locations included in the survey are lively populated with rapid urbanization and industrialization. As such the environment is speedy useful for the multiplication and increase of diseases and stimulates infestation by mosquitoes and other infection. Population density is longer in the urban location. Almost people are employed in government or private institution or industries. People stock water in drum, container and box. *Aedes* breeding sites are increasing, because the changed the feeding habitats of dwelling peoples. The survey was organized in the containers and ovitraps current in different urban and industrial areas of Udaipur district. Containers monthly include plastic mugs, bottles, tyres, canes, tanks, flowerpots, earthen pots, bamboo, buckets and coconut shells. Larvae are reported nurture and found as immerged. From the industrial areas, mostly from the continuing transport sites, factories of the city, various containers were randomly preferred which are mostly found to be infected with of *Aedes aegypti* were reported. The surveillance of breeding area tally of monthly inspections of randomly preferred containers wholly pre-imaginary phages were changed to a beaker after tally mark according to time, date of gathering and sites and nurture in water with food and food powder in the same quantity. Later adult, adults were found as *Aedes aegypti.* In the urban sites homely containers were study monthly from the January 2018 to December 2018. In the industrial site the containers were study in the equal time from January 2018 to December 2018. Oviposition was surveyed monthly applying tyres just as ovitraps that similarly divided in urban and industrial sites. All ovitraps was surveyed monthly, larva and pupae were reported from ovitraps with the help of beakers. Water from the tyres limiting pre-imaging phages were changed to other container with the help of spoons supplied till adult stages and adult examination was confirmed by dichotomous keys of Darsie & Morris (2000). In urban areas a total of 369 ovitraps and in the industrial area 276 ovitraps were inspected monthly from January 2018 to December 2018.

Data Analysis

The percentage of *Aedes aegypti* breeding area was explained as the percentage of water containers infected with minimum larva and pupa. Minimum and maximum percentages were observed between urban and industrial areas. The comparison was initiated using values achieved at the time. Every site was surveyed from January 2018 –

December 2018; ovitrapes: January 2018- December 2018. The analysis of variation of the richness of the *Aedes aegypti* in the urban and industrial environment positions was produced using every month values of breeding sites and egg laying movement lastly we compared the link up of *Aedes aegypti* richness with every month rainfall and temperature. The data were reported by the meteorology department of RCA Udaipur Rajasthan.

RESULTS

Overall 1456 breeding sites of *Aedes aegypti* were recorded out of 4407 wet containers surveyed. In urban sites 560 containers were reported positive for *Aedes aegypti* among the 2399 whole water filled containers recorded. In industrial sites whole 896 positive breeding site were reported out of total 2008 wet containers. In the event of positive ovitraps grand total 63 positive ovitraps were reported in urban sites out of 369 ovitraps and industrial sites a total of 93 positive ovitraps were found out of total 276 ovitraps. The percentage of breeding sites for *Aedes aegypti* in industrial areas is higher than the urban areas. In both the areas situation the percentage of breeding and ovitraps sites of *Aedes aegypti* was notably greater in post monsoon season. The percentage of breeding sites: 30.22% and 52.23%, percentage of positive ovitrapas: 27.77% and 48.43% respectively for urban and industrial areas. The highest infection of breeding sites was recorded in the month of September for the kind of areas (urban: 33.68%, industrial: 63.31%). The percentage of positive ovitraps improved continuously from January to March and then appeared decline in April, May and June. The maximum oviposition life was found in the month of October for urban area and maximum oviposition life was reported in the month of September for industrial areas (Urban 32.55%, industrial 58.33%) Maximum percentages of breeding sites and positive ovitraps were found in the period of July to November and lowest percentages were found in the month of December, January and June.

DISCUSSION

The seasonal variation of riches explained in this survey may permit in deterring the suitable time for the percentage of command measures to prevent dengue in the future. The seasonal prevalence of command measures to prevent dengue in the future. The seasonal prevalence of *Aedes* mosquitoes have been found in the urban and industrial areas of Udaipur district of Rajasthan. The dengue vectors population fluctuation of this survey appears same design with another surveys related along dengue vectors Vezzani *et al.,*(2004) reported the maximum *Aedes aegypti* density along accumulated rainfall above 150mm. Micieli & Campos (2003) reported the near relation of the maximum of *Aedes aegypti* population with more rainfall and the population reduced for the month along decline rainfall.The maximum rainfall was recorded during the month of June, July and August (33.8mm, 54.4mm and 8.8% mm) respectively. Population of larva was recorded to be Maximum during to the particular months, because the heavy rainfall may further produce problem in *Aedes* spread and mating. Toma *et al.,* (1982) reported the higher larval density of *Aedes albopictus* in July and August in Japan and the U.S.A. A Kumar & Lee (2004) found top appearance of *Aedes albopictus* from May to July (34.0%, 35.1% and 30.9%). In our present survey along with we obtained a year round maximum growth of *Aedes* vectors in the study areas with the maximum percentage in the month of September. Many authors Moore *et al.,* 1978; Toma *et al.,* 1982) showed that *Aedes* abundance would be mostly controlled by temperature rather than rainfall. The most important sites of egg laying in the urban areas are the discarded tyres, metal drum, metal containers and plastic bucket. These breading sites do not evaporate easily. Throughout rain water do not overflow speedily.

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Table 1: Seasonal percentages of positive breeding sites for *Aedes aegypti* in urban and industrial areas of Udaipur district.

Seasons	In urban areas		In industrial areas		% of breeding sites	
	Number of positive breeding sites	Total wet containers	Number of positive breeding sites	Total wet containers	Urban areas	Industrial areas
Winter	75	470	140	500	15.95	28.00
Summer	125	595	224	457	21.00	49.01
Monsoon	182	745	345	693	24.42	49.78
Post monsoon	178	589	187	358	30.22	52.23

Table 2: Seasonal percentage of positive ovitraps for *Aedes aegypti* in urban and industrial areas of Udaipur district.

Seasons	In urban areas		In industrial areas		% of positive ovitrapes	
	Number of positive ovitraps for *Aedes aegypti*	Total wet containers	Number of positive ovitraps for *Aedes aegypti*	Total wet containers	Urban areas	Industrial areas
Winter	11	95	23	85	11.57	27.05
Summer	13	97	21	71	13.40	29.57
Monsoon	14	87	18	56	16.09	32.14
Post monsoon	25	90	31	64	27.77	48.43

Table 3: Monthly percentage of breeding sites for *Aedes aegypti* in urban area and industrial sites of Udaipur district; Period- January 2018- December 2018

Months	In urban area		In industrial area		% of breeding sites	
	Number of positive breeding sites for *Aedes aegypti*	Total wet containers	Number of positive breeding sites for *Aedes aegypti*	Total wet containers	Urban areas	Industrial areas
January	23	151	43	161	15.23	26.70
February	25	155	48	169	16.12	28.40
March	39	198	74	152	19.69	48.68
April	42	195	68	142	21.53	47.88
May	44	202	82	163	21.78	50.30
June	20	189	45	173	10.58	26.01
July	51	185	97	175	27.56	55.42
August	48	184	96	176	26.08	54.54
September	63	187	107	169	33.68	63.31
October	87	295	92	176	29.49	52.27
November	91	294	95	182	30.95	52.19
December	27	164	49	170	16.46	28.82

Table 4: Monthly percentages of positive ovitrapas for *Aedes aegypti* in urban and industrial sites of Udaipur district; Rajasthan, Period: January 2018- December 2018

Months	In urban areas		In industrials		% of positive ovitrapas	
	Number of positive ovitraps for *Aedes aegypti*	Total wet containers	Number of positive ovitraps for *Aedes aegypti*	Total wet containers	Urban areas	Industrial areas
January	3	31	6	27	9.67	22.22
February	5	32	8	26	15.62	30.76
March	6	31	9	24	19.35	37.50
April	4	30	7	25	13.33	28.00
May	3	36	5	22	8.33	22.72
June	1	19	2	15	5.26	13.33
July	4	23	4	13	17.39	30.76
August	3	22	5	16	13.63	31.25
September	6	23	7	12	26.08	58.33
October	14	43	17	35	32.55	48.57
November	11	47	14	29	23.40	48.27
December	3	30	9	32	10.0	28.12

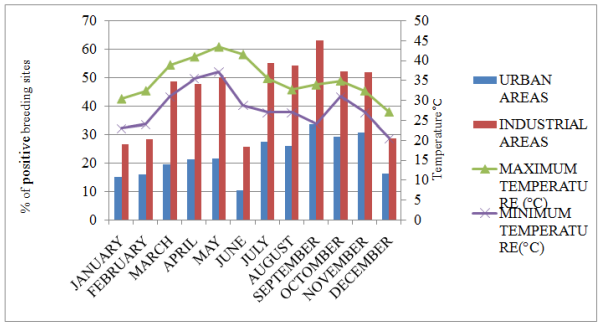

Figure 1: Seasonal percentages of positive breeding sites for *Aedes aegypti* in urban and industrial areas of Udaipur district.

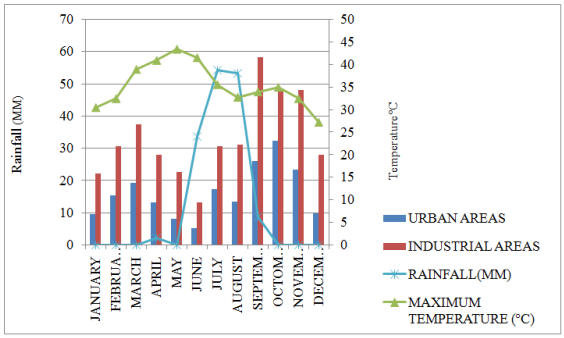

Figure 2: Seasonal percentage of positive ovitraps for *Aedes aegypti* in urban and industrial areas of Udaipur district.

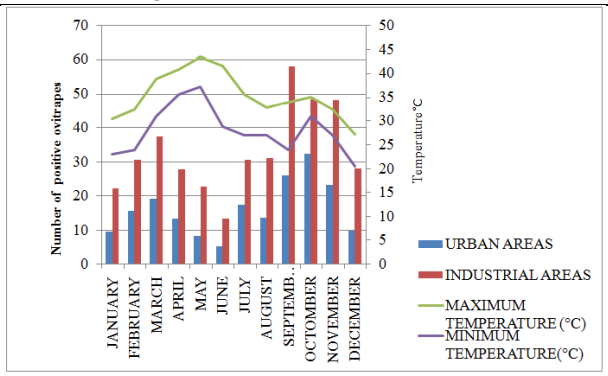

Figure 3: Meteorological condition (temperature) in Udaipur, Rajasthan during the period January 2018- December 2018.

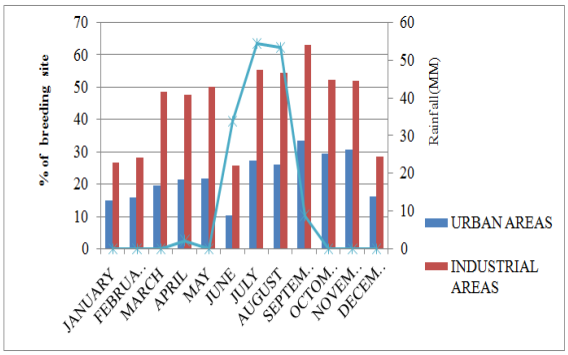

Figure 4: percentage of positive breeding for *Aedes aegypti* in urban and industrial sites of Udaipur district, Rajasthan period January 2018- December 2018

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RESEARCH ARTICLE

Growth Yield Performance of Alfonso Mulberry (*Morus alba* L.) Tree Variety to Fertilization Strategies as Intercropped with Sweet Potato Varieties

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ABSTRACT

Importance of Alfonso mulberry tree variety has not been informed to some farmers in the Philippines and other parts of the world. And there is no study being conducted about growth yield performance of Alfonso mulberry (*Morusalba* L.) tree variety to fertilization strategies as intercropped with sweet potato varieties. This study was aimed to determine the (i) fresh weight biomass yield (g) per plant of Alfonso mulberry tree variety influence by fertilization strategies as intercrop with sweet potato varieties; (ii) number of shoots per plant of Alfonso mulberry tree variety influence by fertilization strategies as intercrop with sweet potato varieties; (iii) weight of shoots (g) per plant of Alfonso mulberry tree variety influence by fertilization strategies as intercrop with sweet potato varieties; (iv) length of the longest shoot (cm) per plant of Alfonso mulberry tree variety influence by fertilization strategies as intercrop with sweet potato varieties; (v) diameter of the longest shoot (mm) per plant of Alfonso mulberry tree variety influence by fertilization strategies as intercrop with sweet potato varieties; (vi) number of leaves per plant of Alfonso mulberry tree variety influence by fertilization strategies as intercrop with sweet potato varieties; and (vii) weight of leaves per plant of Alfonso mulberry tree variety influence by fertilization strategies as intercrop with sweet potato varieties. The study was laid out in a 4 x 4 Split Plot technique of Randomized Complete Block Design (RCBD). Treatment means were compared using the Least Significant Difference Test (LSD). Result of the study revealed that the plants applied with RR 100% Chicken Compost, RR 100% Urea & RR 50% Chicken Compost + RR 50% Urea were comparable with each other and significantly favored on the fresh weight biomass yield (g), number of shoots, weight of shoots (g), length of the longest shoot (cm), diameter of the longest shoot (mm), number of leaves and

weight of leaves (g) per plant of Alfonso mulberry tree variety as intercropped with sweet potato varieties over the plants with no fertilizer application. This study concluded that RR 100% Chicken Compost, RR 100% Urea and RR 50% Chicken Compost + RR 50% Urea fertilization strategies were prominently favored on the growth yield performance of Alfonso mulberry tree variety as intercropped with sweet potato varieties. This intercropping scheme as agroforestry practice can help to increase the income of the farmers, increase carbon stocks in soil and woody biomass and maintain the most soil fertility properties. Moreover, this study can contribute to climate change mitigation and adaptation by reducing threats and enhancing agricultural landscape resiliency, facilitating species movement to more favorable conditions, sequestering carbon and reducing greenhouse gas emissions. This study recommends RR 100% Chicken Compost, RR 100% Urea and RR 50% Chicken Compost + RR 50% Urea to apply the Alfonso mulberry tree plantations as intercrop with high value agricultural crops like sweet potato and other commodities. Extend this study to other parts of the Philippines and world as well, add parameters to be gathered and extend the duration of the study into 90 days and more.

Keyword: Alfonso Mulberry Tree Variety, Growth Yield Performance, Sweet Potato Varieties, Fertilization Strategies, Intercropping Scheme & RCBD Split Plot Design.

INTRODUCTION

Mulberry is a fast growing hard woody perennial plant belonging to the genus *Morus* of the family Moraceae (Pan *et al*., 2008; Yang *et al.,* 2010). It possesses several important characteristics like higher foliage yield, shorter gestation period and stronger environmental adaptability. Globally, more than 15 species of the genus *Morus*are found in subtropical, tropical and temperate regions of Asia, Africa and North America (Perez *et al.,* 2011). The major ones include *Morus alba, Morus nigra, Morus rubra, Morus australis, Morus atropurpurea, Morus cathayana, Morus notabilis* and *Morus mesosygia*. Mulberry is widely recognized for its economic importance. The mulberry leaves are extensively used for feeding and rearing the silkworm, *Bombyx mori* for the production of silk yarn. Basically, the protein contained in the mulberry leaf is converted into the silkprotein (*viz.,* fibroin and sericin) by the silkworm (Ghost et al., 2017). The silk thus produced is used commercially for making excellent silk garments. It is estimated that mulberry silk contributes around 90% of the total global raw silk production, helping significantly to the livelihoods of many people across the globe (Ghost et al., 2017). Apart from this, many nutritional benefits and medicinal values are attributed to the mulberry plant.

The mulberry leaves and fruits rich in protein and vitamins are long being exploited as animal feed/food products in several countries (Ghost et al., 2017). Several studies have shown that different speciesof *Morus* is antioxidant, antiviral, anti-inflammatory, hypolipidemic, anti-hyperglycemic, neuroprotective, anti-HIV and antihypotensive and cytotoxic (Pan and Lou, 2008; Du *et al.,* 2003). The leaves of *Morusalba*bestowed with precious phytochemicals such as coumarins, flavonoids and phenols are found to be useful in reducing blood pressure and cholesterol levelin human body (Sheng-qin*et al.,* 2003; Zhang *et al.,* 2009). A wildly growing rustic mulberry plant, *Morusnigra*is reported to have medicinal values particularlyin treating arthritis, diabetes and rheumatism (Perez *et al.,* 2011). Two new flavonoids have also been isolated from the leaves of this plant species (Wang *et al.,* 2009). The phytochemical constituents isolated from the leaves and fruit extracts of *Morus rubra* have been reported (Sharma *et al.,* 2010). Recently, the antioxidant potential of the extracts obtained from different mulberry plant parts *viz.,* leaves, branches, roots and fruits were investigated by several researchers (Andallu *et al.,* 2001; Andallu *et al.,* 2002; Arfan *et al.,* 2012).

Among the 28 fruits commonly consumed in China, mulberry pulp was characterized by one of the highest values of the ferric reducing antioxidant power (FRAP) at 4.11 m. mol/100 g wet weight (Guo *et al.,* 2003). At present, the occurrence of increased levels of toxic pollutants to the atmosphere, soil and groundwater has caused serious threats

to the environment, ecology and human health. It may be due to rapid industrialization, deforestation & transportation. Perennial woody mulberry plant with its salient characteristic features like extensive root system, high biomass production and strong environmental adaptability demonstrated an encouraging result to stabilize the adverse effects of heavy metals in the diverse polluted soils and useful in controlling atmospheric pollution (Peng *et al.,* 2012; Delplanque *et al.,* 2013; Zhou *et al.,* 2015). *Morus alba* L. has more varieties, one of them is Alfonso. Alfonso mulberry variety has elliptic base shape; serrate leaf margin and purple color of the young leaves; create leaf margin and green young shoots; semi-erect branches; leaves significantly the highest protein and moisture and proved to be the best for silkworms both in bivoltine and multivoltine strains (Villamor, 2008). Field of study was conducted by Shinde *et al.,* (2012) clearly stated that T3 (NPK) complete fertilizer showed a highly significant effect on the number of leaves and weight of mulberry as compared with other treatments of fertilizer.

Related study conducted by Anislag (2019) concluded that any of the varieties of sweet potato could be intercropped in mulberry trees. Anislag et al., (2020) found that 100% RR Urea and 100% RR Chicken Compost significantly influenced the sugar content of the sweet potato tubers as intercropped in mulberry trees. Moreover, recent study was conducted by Anislag, (2021) found that the net income of intercropping schemes between sweet potato & Alfonso mulberry tree variety as affected by sweet potato varieties was highly significant highest in treatment Immitlog sweet potato Variety + Alfonso mulberry trees variety with 184,181.29 pesos per hectare but comparable to the net income of Seven Flores sweet potato variety + Alfonso mulberry trees variety ranked second with 137, 881.71 pesos per hectare. On the other hand, effect of different fertilizers to the net income of sweet potato variety and Alfonso mulberry trees variety revealed highly significant highest to the plants applied with ½ RR chicken compost and ½ RR N with 159,198.00 pesos per hectare but comparable to plants applied with 100% RR Urea alone that ranked second with 128,643. 00 pesos net income per hectare (Anislag, 2021).

Unfortunately, the above-mentioned importance of mulberry trees still unavailable to some provinces in the Philippines and other countries of the world likewise there is no study been conducted on growth yield performance of Alfonso Mulberry (*Morus alba* L.) tree variety to fertilization strategies as intercropped with sweet potato varieties hence this study was conducted.

OBJECTIVES OF THE STUDY

1. Determine the fresh weight biomass yield (g) per plant of Alfonso mulberry tree variety influence by fertilization strategies as intercrop with sweet potato varieties;
2. Determine the number of shoots per plant of Alfonso mulberry tree variety influence by fertilization strategies as intercrop with sweet potato varieties;
3. Determine the weight of shoots (g) per plant of Alfonso mulberry tree variety influence by fertilization strategies as intercrop with sweet potato varieties;
4. Determine the length of the longest shoot (cm) per plant of Alfonso mulberry tree variety influence by fertilization strategies as intercrop with sweet potato varieties;
5. Determine the diameter of the longest shoot (mm) per plant of Alfonso mulberry tree variety influence by fertilization strategies as intercrop with sweet potato varieties;
6. Determine the number of leaves per plant of Alfonso mulberry tree variety influence by fertilization strategies as intercrop with sweet potato varieties; and
7. Determine the weight of leaves per plant of Alfonso mulberry tree variety influence by fertilization strategies as intercrop with sweet potato varieties.

MATERIALS AND METHODS

Research Design

The study was laid out following the 4 x 4 split plot technique in Randomized Complete Block Design (RCBD) replicated three times (Figure 1). The sweet potato varieties were the main plot and the fertilization strategies were the subplot. Each subplot measured 2 m by 1.25 m and per main plot measured 8 m by 5 m. The treatments used were as follows:

Research Procedures

Land preparation

A total of 480 sq m of land was prepared by removing all unwanted plants and materials by the use of sharp bolo, sacks, baskets and wheelbarrows.

Pruning

Three years old planted Alfonso mulberry tree variety in Sericulture Research and Development Institute of Don Mariano Marcos Memorial State University North La Union Campus, Sapilang, Bacnotan, La Union was bottom pruned 30 cm from the ground by the use of pruning shear and saw.

Irrigation

Two days before land cultivation the three years old Alfonso mulberry tree variety was flood irrigated to make the soil soft and provide moisture content. Second irrigation was done two weeks from pruning and consecutive irrigation was done two weeks interval until the termination of the study to facilitate the growth of shoots and leaves.

Land Cultivation

Two days after irrigation the strips of mulberry plantation were cultivated by the use of farm tractors.

Furrowing

Furrows were constructed in between the strips of the Alfonso mulberry tree variety plantation with the use of the Carabao-drawn plow 25 cm deep and 20 cm wide.

Fertilizer application

Recommended rate fertilizers based on the soil analysis result from Department of Agriculture Bureau of Soils in Region 1 Philippines were basally applied & buried in between the constructed furrows then were covered by the soil right after the application. Second application was done 25 days after the first application.

Planting

Seven Flores, Seri Kenya, Immitlog and Violeta Sweet potato varieties were planted in between the strips of pruned Alfonso mulberry trees.

Hilling up management

This was done 15 days after the first fertilizer application to cover the root systems of Alfonso mulberry trees.

Weeding

This was done every last week of the month to control the growth of unwanted plants.

Harvesting

This was done 60 days after pruning (DAP). The shoots and leaves were harvested by the use of pruning shear and they were placed and covered by the cloth to avoid wilting and they were placed in a cool storage room building of Sericulture Research and Development Institute (SRDI) for the data gathering procedure.

Data Gathered

Fresh weight biomass yield (g) per plant. This was done by weighing the harvested leaves and shoots per plant. Number of shoots per plant. This was done by counting the number of shoots developed per plant. Weight of shoots (g) per plant. This was done by removing all the leaves attached to the shoots per plant then the shoots were weighted using the electronic weighing scale. Length of the longest shoot (cm) per plant. This was done by measuring the length of the longest shoot per plant using the meter stick. Diameter of the longest shoot (mm) per plant. This was done by measuring the diameter of the longest shoot with the use of a digital tree caliper. Number of leaves per plant. This was done by counting all the leaves attached per plant shoot. Weight of leaves (g) per plant. This was done by weighing the leaves using the electronic weighing scale.

Data Analysis

All the data gathered were summarized, presented and subjected for analysis of variance (ANOVA) in RCBD split plot design. Treatment means were compared using the Least Significant Difference Test (LSD).

RESULTS AND DISCUSSION

Fresh weight biomass yield (g).

Table 2 and Figure 2 present the fresh weight biomass yield (g) per plant of Alfonso mulberry tree variety as influenced by fertilization strategies 60 DAP. The highest fresh weight biomass yield was observed from the plants applied RR 50% Chicken Compost + RR 50% Urea with a mean of 370.96 g followed by the plants applied RR 100% Chicken Compost with a mean of 366.96 g and the plants applied RR 100% Urea with a mean of 339.25 g while the lowest fresh weight biomass yield were observed from the plants with no fertilizer application with a mean of 93.69 g. Statistical analysis showed that there was a significant effect of fertilization strategies on the fresh weight biomass yield (g) of Alfonso mulberry tree variety. Comparison among means revealed that the plants applied RR 100% Chicken Compost, RR 100% Urea and RR 50% Chicken Compost + RR 50% Urea were comparable with each other and significantly higher over the plants with no fertilizer applications. This result implies that RR 100% Chicken Compost, RR 100% Urea and RR 50% Chicken Compost + RR 50% Urea favored on the fresh weight biomass yield (g) of Alfonso mulberry tree variety.

Number of shoots

Table 3 and Figure 3 present the number of shoots per plant of the Alfonso mulberry tree variety as influenced by fertilization strategies 60 DAP. The highest number of shoots were observed from the plants applied RR 50% Chicken Compost + RR 50% Urea with a mean of 8.00 followed by the plants applied RR 100% Chicken Compost with a mean of 7.00 and the plants applied RR 100% Urea with a mean of 6.00. The lowest number of shoots observed from the plants with no fertilizer application had a mean of 3.00.Statistical analysis revealed that there was a significant effect of fertilization strategies on the number of shoots of Alfonso mulberry tree variety. Comparison among means showed that the plants applied RR 100% Chicken Compost, RR 100% Urea and RR 50% Chicken Compost + RR 50% Urea were comparable with each other and significantly higher over the plants with no fertilizer applications. This result implies that RR 100% Chicken Compost, RR 100% Urea and RR 50% Chicken Compost + RR 50% Urea favored on the production of shoots of Alfonso mulberry tree variety.

Weight of shoots (g).

Table 4 and figure 4 present the weight of shoots per plant of Alfonso mulberry tree variety as influenced by fertilization strategies 60 DAP. Heaviest shoots were observed from the plants applied RR 100% Urea with a mean of 103.92 g followed by the plants applied RR 50% Chicken Compost + 50% RR Urea with a mean of 102.96 g and the plants applied RR 100% Chicken Compost with a mean of 101. 33 g while the least weight of shoots were observed from the plants with no fertilizer application had a mean of 22.50 g. Statistical analysis showed that there was a significant effect of fertilization strategies to the weight of shoots of Alfonso mulberry tree variety. Comparison among means revealed that the plants applied RR 100% Chicken Compost, RR 100% Urea and RR 50% Chicken Compost + RR 50% Urea were comparable with each other and significantly higher over the plants with no fertilizer applications. This result implies that RR 100% Chicken Compost, RR 100% Urea and RR 50% Chicken Compost + RR 50% Urea were favored on the weight of shoots of Alfonso mulberry tree variety.

Length of the longest shoot (cm).

Table 5 and Figure 5 present the length of the longest shoot (cm) per plant of Alfonso mulberry tree variety as influenced by fertilization strategies 60 DAP. The longest length of shoot were observed from the plants applied RR 100% Urea with a mean of 98.55 cm followed by the plants applied RR 100% Chicken Compost with a mean of 97.07 cm and the plants applied RR 50% Chicken Compost + 50% Urea with a mean of 96.96 cm while the shortest length of shoot were observed from the plants with no fertilizer application had a mean of 85.53 cm. Statistical analysis showed that there was a significant effect of fertilization strategies on the length of the longest shoot of Alfonso mulberry tree variety. Comparison among means revealed that the plants applied RR 100% Chicken Compost, RR 100% Urea and RR 50% Chicken Compost + RR 50% Urea were comparable with each other and significantly higher over the plants with no fertilizer applications. This result implies that RR 100% Chicken Compost, RR 100% Urea and RR 50% Chicken Compost + RR 50% Urea were favored on the development & growth of shoots of Alfonso mulberry tree variety.

Diameter of the longest shoot (mm)

Table 6 and Figure 6 present the diameter of the longest shoot per plant of the Alfonso mulberry tree variety as influenced by Fertilization Strategies 60 DAP. The highest diameter of the longest shoot of Alfonso mulberry tree variety were observed from the plants applied RR 100% Chicken Compost with a mean of 3.80 mm followed by the plants applied RR 100% Urea with a mean of 3.56 mm and the plants applied RR 50% Chicken Compost + RR 50% Urea with a mean of 3.46 mm while the lowest diameter of the longest shoot were observed from the plants with no fertilizer application with a mean of 1.51 mm.

Statistical analysis showed that there was a significant effect of the fertilization strategies on the diameter of the longest shoot (mm) of Alfonso mulberry tree variety. Comparison among means revealed that the plants applied with RR 100% Chicken Compost, RR 100% Urea and RR 50% Chicken Compost + RR 50% Urea were comparable with each other and significantly higher over the plants with no fertilizer applications. This result implies that RR 100% Chicken Compost, RR 100% Urea and RR 50% Chicken Compost + RR 50% Urea were favored on the increment of the diameter of Alfonso mulberry tree variety.

Number of leaves.

Table 7 and figure 7 present the number of leaves per plant of Alfonso mulberry tree variety as influenced by Fertilization Strategies 60 DAP. The highest number of leaves were observed from the plants applied RR 100% Chicken Compost with a mean of 119.17 followed by the plants applied RR 50% Chicken Compost + RR 50% Urea with a mean of 119.04 and the plants applied RR 100% Urea with a mean of 104.52 and the lowest number of leaves were observed from the plants with no fertilizer application had a mean of 63.08.

Statistical analysis showed that there was a significant effect of fertilization strategies on the number of leaves of the Alfonso mulberry tree variety. Comparison among means revealed that the plants applied with RR 100% Chicken

Compost, RR 100% Urea and RR 50% Chicken Compost + RR 50% Urea were comparable with each other and significantly higher over the plants with no fertilizer applications. This result implies that RR 100% Chicken Compost, RR 100% Urea and RR 50% Chicken Compost + RR 50% Urea were favored on the production of the most number of leaves of the Alfonso mulberry tree variety.

Weight of Leaves (g)

Table 8 and Figure 8 present the weight of leaves (g) per plant of Alfonso mulberry tree variety as influenced by Fertilization Strategies 60 DAP. The heaviest weight of leaves were observed from the plants applied RR 50% Chicken Compost + RR 50% Urea with a mean of 209.46 g followed by the plants applied RR 100% Chicken Compost with a mean of 201.33 g and the plants applied RR 100% Urea with a mean of 183.01 g. Least weight of leaves observed from the plants with no fertilizer application had a mean of 47.63 g. Statistical analysis showed that there was a significant effect of fertilization strategies on the weight of leaves of the Alfonso mulberry tree variety. Comparison among means revealed that the plants applied RR 100% Chicken Compost, RR 100% Urea and RR 50% Chicken Compost + RR 50% Urea were comparable with each other and significantly higher over the plants with no fertilizer applications. This result implies that RR 100% Chicken Compost, RR 100% Urea and RR 50% Chicken Compost + RR 50% Urea were favored on the production of heaviest leaves of the Alfonso mulberry tree variety.

CONCLUSIONS

This study concluded that RR 100% Chicken Compost, RR 100% Urea and RR 50% Chicken Compost + RR 50% Urea fertilization strategies were prominently favored on the growth yield performance of Alfonso mulberry tree variety as intercropped with sweet potato varieties. This intercropping scheme as agroforestry practice can help to increase the income of the farmers, increase carbon stocks in soil and woody biomass and maintain the most soil fertility properties. Moreover, this study can contribute to climate change mitigation and adaptation by reducing threats and enhancing agricultural landscape resiliency, facilitating species movement to more favorable conditions, sequestering carbon and reducing greenhouse gas emissions.

RECOMMENDATIONS

This study recommends RR 100% Chicken Compost, RR 100% Urea and RR 50% Chicken Compost + RR 50% Urea to apply the Alfonso mulberry tree plantations as intercrop with high value agricultural crops like sweet potato and other commodities. Extend this study to other parts of the Philippines and world as well, add parameters to be gathered and extend the duration of the study into 90 days and more.

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Table 1. Treatments used of the Study

Main Plot	Subplot
V_1 - Seven Flores	F_0 - No Fertilizer Application (control)
V_2 - Seri Kenya	F_1 - Organic Fertilizer (RR 100% Chicken Compost - 3t/ha)
V_3 - Immitlog (Check Variety)	F_2 – Inorganic Fertilizer (RR 100% Urea – 60kg/ha
V_4- Violeta	F_3 – 50% RR Chicken Compost + 50% RR urea

Table 2: Fresh Weight Biomass Yield (g) per plant of Alfonso Mulberry tree variety as influenced by Fertilization Strategies 60 DAP

Fertilization Strategies	Fresh Weight Biomass Yield (g)
F_0 - No Fertilizer Application (control)	93.69 b
F_1 - RR 100% Chicken Compost	366.96 a
F_2 - RR 100% Urea	339.25 a
F3 - RR 50% Chicken Compost + 50% Urea	370.96 a

Table 3:- Number of Shoots per plant of Alfonso Mulberry tree variety as influenced by Fertilization Strategies 60 DAP

Fertilization Strategies	Number of Shoots per Plant
F_0 - No Fertilizer Application (control)	3.00 b
F_1 - RR 100% Chicken Compost	7.00 a
F_2 - RR 100% Urea	6.00 a
F3 - RR 50% Chicken Compost + 50% Urea	8.00 a

Table 4:- Weight of Shoots (g) per plant of Alfonso Mulberry tree variety as influenced by Fertilization Strategies 60 DAP

Fertilization Strategies	Weight of Shoots (g)
F_0 - No Fertilizer Application (control)	22.50 b
F_1 - RR 100% Chicken Compost	101.33 a
F_2 - RR 100% Urea	103.92 a
F3 - RR 50% Chicken Compost + 50% Urea	102.96 a

Table 5:- Length of the Longest Shoot (cm) per plant of Alfonso Mulberry tree variety as influenced by Fertilization Strategies 60 DAP

Fertilization Strategies	Length of the Longest Shoot (cm)
F_0 - No Fertilizer Application (control)	85.53 b
F_1 - RR 100% Chicken Compost	97.07 a
F_2 - RR 100% Urea	98.55 a
F3 - RR 50% Chicken Compost + 50% Urea	96.96 a

Table 6:- Diameter of the Longest Shoot (mm) per plant of Alfonso Mulberry tree variety as influenced by Fertilization Strategies 60 DAP

Fertilization Strategies	Diameter of the Longest Shoot (mm)
F_0 - No Fertilizer Application (control)	1.51 b
F_1 - RR 100% Chicken Compost	3.80 a
F_2 - RR 100% Urea	3.56 a
F3 - RR 50% Chicken Compost + 50% Urea	3.46 a

Table 7:- Number of Leaves per plant of Alfonso Mulberry tree variety as influenced by Fertilization Strategies 60 DAP

Fertilization Strategies	Number of Leaves
F_0 - No Fertilizer Application (control)	63.08 b
F_1 - RR 100% Chicken Compost	119.17 a
F_2 - RR 100% Urea	104.52 a
F3 - RR 50% Chicken Compost + 50% Urea	119.04 a

Table 8:- Weight of Leaves (g) per plant of Alfonso Mulberry tree variety as influenced by Fertilization Strategies 60 DAP

Fertilization Strategies	Weight of Leaves (g)
F_0 - No Fertilizer Application (control)	47.63 b
F_1 - RR 100% Chicken Compost	201.33 a
F_2 - RR 100% Urea	183.01 a
F3 - RR 50% Chicken Compost + 50% Urea	209.46 a

BLOCK				
I		II		III
V_1F_2		V_4F_1		V_2F_1
V_1F_0		V_4F_0		V_2F_2
V_1F_3		V_4F_3		V_2F_3
V_1F_1		V_4F_2		V_2F_0
V_4F_1		V_2F_3		V_4F_3
V_4F_0		V_2F_2		V_4F_2
V_4F_2		V_2F_0		V_4F_0
V_4F_3		V_2F_1		V_4F_1
V_2F_0		V_3F_2		V_3F_3
V_2F_2		V_3F_3		V_3F_1
V_2F_3		V_3F_1		V_3F_0
V_2F_1		V_3F_0		V_3F_2
V_3F_2		V_1F_1		V_1F_2
V_3F_0		V_1F_3		V_1F_0
V_3F_3		V_1F_2		V_1F_3
V_3F_1		V_1F_0		V_1F_1

Fig. 1. Experimental Lay out

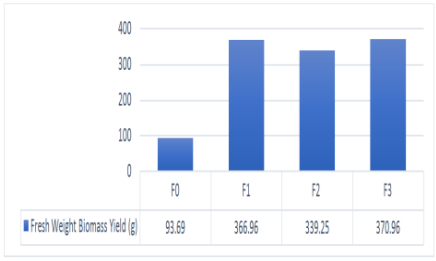

Figure 2. Fresh Weight Biomass Yield (g) per plant of Alfonso Mulberry tree variety as influenced by Fertilization Strategies 60 DAP

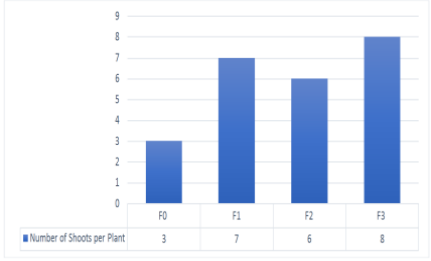

Figure 3. Number of Shoots per plant of Alfonso Mulberry tree variety as influenced by Fertilization Strategies 60 DAP

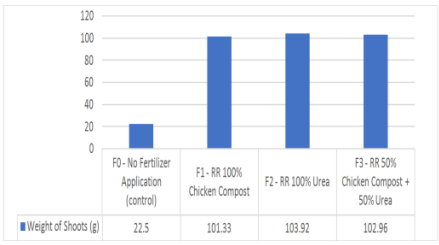

Figure 4. Weight of Shoots (g) per plant of Alfonso Mulberry tree variety as influenced by Fertilization Strategies 60 DAP

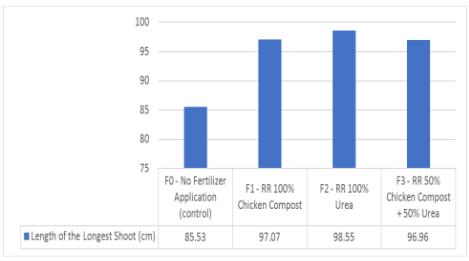

Figure 5. Length of the Longest Shoot (cm) per plant of Alfonso Mulberry tree variety as influenced by Fertilization Strategies 60 DAP

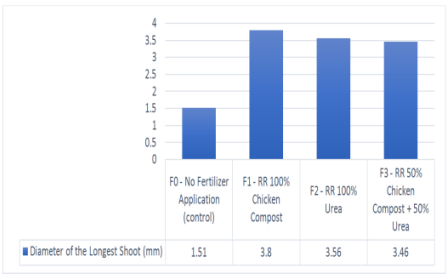

Figure 6. Diameter of the Longest Shoot (mm) per plant of Alfonso Mulberry tree variety as influenced by Fertilization Strategies 60 DAP

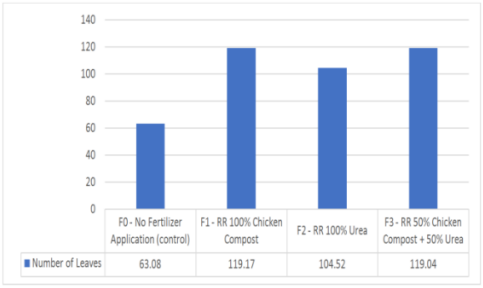

Figure 7. Number of Leaves per plant of Alfonso Mulberry tree variety as influenced by Fertilization Strategies 60 DAP

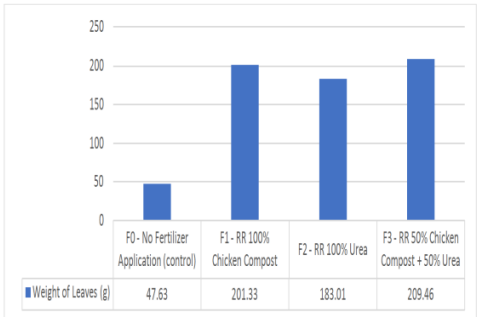

Table 8:- Weight of Leaves (g) per plant of Alfonso Mulberry tree variety as influenced by Fertilization Strategies 60 DAP

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RESEARCH ARTICLE

Empirical Study on Pollution in India - Pre and Post Lockdown

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ABSTRACT

Covid 19 spread through the globe through human transmission. According to the doctors, the only way to curb this lethal virus is by maintaining social distancing and wearing a mask. The virus brought chaos and had a huge impact so far after world war. The lockdown put an end to social, economic, and industrial activities to a sudden stop and enhance the environment. The wildlife and nature started to rebuild themselves. The major problem faced by all major cities was air pollution. The poor air quality, which was affecting people with many diseases before lockdown now started to enhance. Studies show that before and after the lockdown, the chlorofluorocarbons, nitrogen oxide, carbon dioxide, and other gases decreased after implementing the lockdown. The major cities being the hub for air pollution saw a massive change after the lockdown. The pollutant levels of PM 2.5, PM12, NO2, NH3, SO2, and CO are the major ones in determining the air quality in a particular region. The PM2.5 are smaller particles observed through a microscope. They are smaller than the PM10 particles in the air. These gases can only be controlled when there are many forests and trees due to the increase in demand for wood, leading to massive deforestation. Both are taking simultaneously and leading to an imbalance in nature. These pollutants can lead to global warming and also the melting of ice caps in the Antarctic Ocean. The virus became a blessing to the environment and wildlife. This study gives an insight into the type of pollutions affecting the environment and our health. Provides solutions to control the pollution levels and providing a healthy environment for our future.

Keywords: Covid 19, Lockdown, Pollution levels, Air Quality levels, and Global warming

INTRODUCTION

The lethal virus spread worldwide was named Covid 19 by the World Health Organization (WHO). This situation was called an emergency around the World by WHO. The virus outbreak was first seen in December 2019 in Wuhan city, China. Later noticed that it had some links to the local city animal market. So the people from China traveled

around, and the spread of the virus took place. Soon this was detected and was report to WHO, and they declared the situation a pandemic. The virus spread within a blink of an eye through the globe, leading to traumas worldwide. From a big city to a small village, the virus has spread around the lockdowns extended for few days to few months. [22] Studied air pollution levels in England pre and post-lock-down and compared the death rates. [5] Find indicative PM values for the period of Feb-2020 to July-2020 and compare the indicators like pollution, climate and covid cases, and recoveries. [14] Concludes air pollution effect associated to covid and the findings helpful for government agencies and other agencies. [18] A report on the air pollution trends and future outbreaks. [11] Studied the increase in the oxygen and mineral levels. [12] The study shed light on the effect of covid 19 on renewable energy. [10] studied the emotions and feelings of the people during the different phases of lockdown. The comments of the people during the lockdown period. [1] Presented pollution effects and its importance of controlling. [3] [4] Studied the impacts of lockdown effects of air pollution on the health factors like life expectancy and diseases in India. [16] Studied the effect of crops waste burning and its effects, [6] and factors that changed the transparency of the water levels in Lagoon after the lockdown. [17] The first case in India was observed in Kerala on January 30, 2020. Within no time, the virus spread around, the Indian central government understood the threat of the virus and declared a lockdown across the nation. By this, all the activities shut down suddenly, significant hubs like cinema theaters, malls, and offices. [18] The human behavioral factors that impacted the nature and environmental changes by this change in the human behavioral made a positive result to the wildlife and nature. As a result, all pollutions levels like land, water, and air have fallen on a large scale. Pollutions are a primary global concern growing globally, and the lockdowns made the levels of pollution decrease. [19]In developing countries like India, the primary sources of pollution are construction, burning of fossil fuels and vehicles, thermal energy, transportation, road dust, industries, waste burning, agriculture burning, and cooking by using fossil fuels. 7.9 billion population in the World in the year 2021 spread across 249 countries, out of which many big countries are facing pollution as a significant issue. Major cities are on the top of this pollution list where millions of people live.

Aerosol levels decreased after the lockdown, captured by the NASA satellites shows in Fig-1. Delhi stands in the top ten most polluted cities list. [8]Studies on various levels of PM2.5, PM10, and NO2 are very unhealthy, leading to acute health problems, breathing issues, asthma attacks, and even death from cardio respiratory diseases. Many people live in these cities are being affected, leading to a significant concern among the citizen and nature activists. But the lockdown stopped the human activities, making NO2 drop to 40 – 50 % lesser—making a significance in India. (CSE ozone) due to the better air quality, many resources show an increase in the ozone layer. These are very useful to save us from harmful UV rays coming from the sun. The spread of Covid made the people stop stepping out of their houses. The lockdown has plumped the nation's economy, but the country regained its natural beauty.

METHODOLOGY

An empirical study was conducted on air quality considering PM2,5 and PM10. Oxygen is a crucial compound for any living thing to survive on the earth. However, pollution affects the oxygen rates in the atmosphere leading to many ecological imbalances. This study collects the data of significant cities Delhi and Hyderabad and steps to control pollution after lockdown.

Factors Affecting the Environment

The major cities used to have peak levels of pollutions. All the factories and industry's fumes mix in the air, thus leading to contamination. India being a developing nation, lots of constructions take place daily, leading to deforestation. [23] 65% of the Indian population lives in rural areas, and the primary source is burning for wood and biomass for daily uses like cooking and fire in these areas, leading to releasing CO2 and greenhouse gases into the air, cooking daily two to three times using this method. [24]People in rural areas die due to indoor air pollution and inhalation of carbon gases, affecting the delay in monsoon rains. India is one of the largest producers of grains and crops, with 16.9 million farmers. [24] Certain states in the country grow different crops, and lots of residual waste is

produced and is not disposed of correctly. States like Uttar Pradesh, Punjab, and Haryana burn 25% of the agricultural crop residue every year on farms. The burning of agricultural waste releases deadly gases into the environment. India is the World's second most populated country, with millions of people traveling daily. The country is having around [21] 295 million vehicles from the financial year 1951 to 2021. Mixing cheap hydrocarbon into the fuels, this type of adulterations leads to a personal profit but leads to significant air pollution and affects the air quality. Adding to this the traffic congestions area considerable problem in India. Fuel consumption and pollution per trip increase when a car travels at a low speed. An average speed of 55-75 is the ideal speed, and an average speed is below 40 kmph, then it would emit the pollutants twice into the air. Bengaluru is at the top in traffic congestion in India, followed by Mumbai, Pune, and Delhi. The average speed in these major cities is around 20 kilometers per hour, leading to more emissions from vehicles and fuel consumption. The roads in the major cities have to widen to overcome the slowdown of vehicles in the country. The emission of gases is increasing at a tremendous rate. The heat coming from the sun is rising due to the factories and the industries depleting the ozone.

Major Causes for the Pollution

People live in rural and urban areas affected by air pollution for the past two to three decades. Prolonged exposure to these gases can lead to asthma, breathing problems, lung infections, skin infections, eye-related problems, cancer, and decreases in life span where most people face heart diseases, asthma, and breathlessness. Air pollution is a mixture of various gases and compounds leading to a wide range of complications. The people living in many major cities are being affected by this factor. Generally, the pollution mainly consists of the gases nitrogen oxide (NO), volatile organic compounds (VOC), carbon dioxide (CO_2), sulfur oxide (Sox), and chlorofluorocarbons (CFCs) affecting the ozone. These gases are present everywhere. The atmosphere primarily consists of two crucial gases, Nitrogen, and Oxygen. The ozone layer (O_3) is classified into two types Ground-level ozone and higher-level ozone. The ground-level ozone is considered harmful for human life, especially for children and older people. Cars and other motor vehicles release Nitrogen Oxide (NO) as one of the by-products. Moreover, indoor sources burn fuel for appliances stoves, ovens, heaters, and fireplaces release NO gases, thus causes headaches, breathing problems, and eye irritations. The Volatile Organic Compounds (VOC) also play a significant role in air pollution, leading to many problems. The primary sources of this are methane, chlorofluorocarbons, and hydrocarbons generally formed during industrial works like construction works like panting and aerosol spring, leading to shortness of breathiness. Carbon dioxide (CO_2) comes from various combustion types in industrial and domestic environments, from power plants and transport. Both gases have the Greenhouse Effect as a direct consequence and therefore influence the current Global Warming situation. The sulfur forms Sulfur Oxides (S0), Sulphur Dioxide (SO_2), and Sulphur Trioxide (SO_3). Combustion of coal or oil burns produces Sulphur Dioxide, which plays a role in pollution and health.

$SO_2 (g) + ½ O_2(g) \Leftrightarrow SO_3 (g)$.

SO_3 from SO_2, with Sulphur trioxide being the cause of acid rain. These are the primary gases that affect the air quality in the major cities of India. In addition, the (CFCs) and (HFCs) damage immunity and lead to skin cancer, depleting massive ozone layers.

Cancer and Death Rate

Toxin gases are affecting the lungs and causing lung cancer. [13]Concluded that every three minutes, a child dies in India due to inhalation of the toxin gases in the atmosphere. No matter from an infant to an old adult is being affected. [2]Exposure to$PM_{2.5}$ for every ten micrograms per cubic meter increased the risk of dying from cancer by 22%.The upper digestive tract cancer, the risk was 42 percent higher, and for the cancers of the accessory digestive organs, including the liver, bile ducts, gall bladder, and pancreas, the mortality risk was 35 percent higher. For breast cancer, the mortality risk was 80 percent higher. Lung cancer, the mortality risk was 36 percent higher. All figures are just in a hike of 10 µg/m3 increased exposure to $PM_{2.5}$, explaining the risk of exposure to 10 micrograms of $PM_{2.5}$. The annual mean exposure to $PM_{2.5}$ in India is around 89.9 $\mu g/m^3$ in 2017; exposure to these produces problems in breathing. These PM levels were highest in Delhi in 2017, leading to the development of cardiovascular diseases and reducing a person's life expectancy. [7]The pollution levels in Delhi affect a non-smoker into a smoker, causing lung

cancer, and 70% of the people under 50 years effected according to the survey conducted on 150 people, influencing the majority of the youth in the nation. Exposure to household air pollution related to carotid intima-media thickness (CIMT) problems affect more than 10 million Indian people yearly. The pollution rates must be decreased for the benefit of the human species to survive on the earth. However, the risk of cancer reduced after the lockdown due to a significant decrease in PM10 and PM 2.5 levels. Air pollutions had killed over 7 million people worldwide in a year, making it a crucial problem and concern. This situation is not only in India but also in all around the major countries. Not going out of the house is not the solution for this, but maintaining a good diet, proper fitness, and good exposure to the sun can reduce the chances of getting affected. The below table shows us the required levels of PM2.5, which are excellent and hazardous to human survival. These increasing levels are affecting human health.

Pollution Study on Lockdown Effects

The covid has changed the way of living. Everyone is wearing a mask to protect against the deadly virus. During the multiple states and central quarantines in India, the air quality has developed in the major cities due to the enforcement of lockdown. The below section provides the air quality details about pre and post-lockdown situations and their comparisons in Delhi and Hyderabad cities.

Delhi City

Delhi is the capital territory of India, surrounded by companies and industries. Millions of people commuter daily via road, metro, cars, and public transports. Due to the vast population and various sectors, this has degraded the air quality of Delhi and the surrounding regions at a tremendous rate. The first lockdown ended all the industrial activities, vehicles on roads, and public gatherings. The lockdown restrictions led to the improvement of the air quality immediately a few weeks after the lockdown. Many people working in companies and industries travel from Noida, Ghaziabad, and Gurugram. The nearby cities of Delhi from where most of the working classes people travel to the Delhi through the public transport. After lockdown, the total number of motor vehicles enter the Delhi region has decreased. According to the primary transport system used in Delhi are metro and buses. The Delhi metro rail cooperation (DMCR) shows the passenger drop from 2.7 million to 900,000 before and after the lockdown. Similarly, the Delhi transport corporation shows a decrease of 59% passengers in March's last financial year 2020. This data shows a massive decline in the number of riders. According to the Centre's System of Air Quality Weather Forecasting and Research (SAFAR), PM2.5 reduced by 35% during the social lockdown, PM10 by 43%, and 52% compared to the before lockdown period the month of March 1 to 14, 2020.

Pre-Lockdown vs. Post Lockdown– Delhi City

The below graphs show the comparison of the significant effecting pollutants particles from 2018 to 2020. Delhi government declared the lockdown to curb the virus, and the pollution levels have been off the grid. As a result, the sky started coming back to its standard color. Due to the lockdown, 50% of vehicles are not running on roads. Delhi has been suffering from bad air quality for the last few years, but the complete scenario had changed declared lockdown. From November to March, this region faces a thick layer of smog through the city, becoming a significant health concern. The lockdown has become a blessing in disguise to the citizen's living in the Delhi regions. Due to changes in the situation, observed a clear pollution difference in Delhi.

The belowFig-2 shows the PM2.5 level trends from 2018 to 2020 in Delhi city, covers the pre and post-lockdown situations. Comparison between three years span for every five days, taken data [15] for every month 01, 05, 10, 15, 20 and 25.

The below Fig-3 shows the PM10 level trends from 2018 to 2020 in Delhi city, covers the pre and post-lockdown situations. Comparison between three years span for every five days, taken data [15] for every month 01, 05, 10, 15, 20 and 25.

Hyderabad City

Hyderabad is the technological, IT, and industrial center of the southern part of India located in Telangana state. It is known for the famous Mughals architecture and monuments in the state. It is a central state of south India for massive developments in technology, education, and health. Millions of people daily commute to Hyderabad for their jobs. Transportation is the primary source of carbon. The city has expanded tremendously in the last few decades. Due to industrial opportunities, the number of people migrating to Hyderabad has increased. The levels of PM2.5 were on a peak increase in the year 2019, which led to a major concern. The air quality has been decreasing due to rapid industrialization and urbanization in the city. The citizens most use the buses, metro, cars, and bikes in Telangana are the most used transport sources. After lockdown, the use of these motor vehicles has decreased; as a result, the quality of the air started to get better. The gases released by these motor vehicles like Sulfur Dioxide (SO2), Nitrogen Oxides (NOx), carbon atoms are the major gases found in the air, affecting human life and nature.

Pre lockdown Vs. Post Lockdown– Hyderabad City

The primary sources of the air pollution observed are the gases released due to motor vehicles, industrial waste, and construction dust. The year 2020 recorded a lower rate compared to the year 2019. In Mar 2020, the social lockdown declared, the air quality has drastically improved. Within the following weeks, air quality under the category of "Good. The air quality in Telangana was mostly under the category of "Satisfactory" before the lockdown. Astonishingly, from the last few months after the lockdown was declared, the levels of the deadly gases have been decreased, and natural flora and fauna started to grow. Pollution decrease due to the restrictions on the traffic and the slowdown of the industrial and construction works. The health risk was fallen by 9.8% in the state after the decrease in the pollution levels. The nitrogen levels had a decline by 38% after the restrictions on the traffic. The main PM2.5 also saw a decline by 25% after the lockdown. Pollution in Hyderabad city causes by 50% from the vehicle, and the other 50%from Industrial work and buildings (demolition, construction, painting, and deforestation). National Air Quality Monitoring Programme (NAMP) stations have reported that on the first day of the lockdown, air quality was recorded as 'Good' AQI of 43 on May 19 at Uppal, which was always under "Bad" AQI. Even the regions of Balanagar saw a steep fall in pollution levels from 166 to 93 AQI on May 19, which makes a better air quality

The below Fig-4 shows the PM2.5 level trends from 2018 to 2020 in Hyderabad city, covers pre and post-lockdown situations. Comparison between three years span for every five days, taken data [15] for every month 01, 05, 10, 15, 20 and 25.

RESULTS AND DISCUSSION

After the spread of the coronavirus, social distancing and lockdown became the only source of curb the virus. The people stopped all kinds of activities. All the government and media forms brought awareness among the people, which reduced the number of people on the road lead to reduced the major pollution components like PM2.5, PM10, CO2, and NOx observed mainly in major cities in India. When these levels decreased, the O3 also started to regain in some regions. The people are slowly starting to go back to their jobs after started massive vaccination drive started. After lockdown, it could increase the pollution levels back to normal levels once everything is in place. Proper precautions were taken to control the pollution levels after seeing the benefits while in the lockdown period. Some of the precautionary steps described below allow us to reduce pollution after a lockdown in the account of learning in the lockdown period.

Work from Home

Working from home is beneficial for employees and employers. The company saves lots of capital on the employee's transportation and office expenditure. The employees save time and money for transportation. A hybrid solution (partially working from Office option based on projects situation / 50% from offices) is a good option for the

companies to look and adopt, reducing the cost for both the employees and the employer. For this, the number of vehicles on the road will decrease drastically, leading to reduced pollution levels. The companies must encourage their employees to use the bicycle or use public transport at least twice a week.

Electric Cars Promotion

Electric motors are another solution to replace with fuel-burning motor vehicles. Electric vehicles used the electricity to run and do not release any pollutants into the air. Nowadays, all the buses, cars, bikes, and auto rickshaws are being available in the market, and automobile companies invest in developing electric vehicles on a large scale after Covid. The government in India moves towards electric buses in road transport and provides subsidies to the individuals to promote buying electric vehicles. People must start buying electric cars that are more economical and do not need fuel to run. In the growing fuel rate in the nation, purchasing an electric vehicle would be more frugal and eco-friendlier to the globe and the buyer. The government should also bring awareness among the people about electric vehicles and their uses.

Public Transportation

India has the second-largest population after China, where billions of people commute daily for their work. Many people are not aware of carpooling and bike pooling. Using public transport system can decrease the traffic levels in the city and the pollution, in this situation may not be feasible due to social distancing for some more time until the corona ends. The people must use public transport instead of self-vehicles, reducing the number of vehicles on the road.

Household and Agriculture Pollution

Many people in India still live-in rural areas. They use outdoor tools for cooking food daily twice or thrice, leading to significant pollution levels in villages, indoor and outdoor pollutions, and health hazards, mostly lung-related problems. Even most of the population in India does agriculture, where the farmers in the Haryana region are burning crops to make the land available for subsequent cultivation. The government and the agriculture officials must bring awareness among these people and prevent them from harming nature and themselves.

CONCLUSIONS

Concluding that the majority of the pollution from transport vehicles, Industries, and burning agriculture waste. After lockdown government and the public have to adopt precautions to sustain the air pollution at the same level were achieved in the lockdown period. Both the government and citizens must feel responsible for themselves as well as their fellow humans. Government has to develop biodegradable substances for farmers to decompose agricultural waste instead of burning it. The study was conducted for Delhi and Hyderabad pollution data from [15] and observed that the pollution levels decreased while lockdown and maintained the same after lockdown. The government and citizens / local government has to take precautions to maintain the same state. Further study can be conducted on other states/cities in the country for better understand and steps to be taken care of from region to region. The two cities we have taken are metro cities, and the same will not be applicable for other cities and towns.

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Cancer and Death Rate

PMI	Air Quality Index	Index Value
00.0 to 12.0	Good	00 to 50
12.1 to 35.4	Moderate	51 to 100
35.5 to 55.4	Unhealthy for sensitive group	101 to 150
55.5 to 150.4	Unhealthy	151 to 200
150.5 to 250.4	Very Unhealthy	201 to 300
250.5 to 500	Hazardous	301 to 500

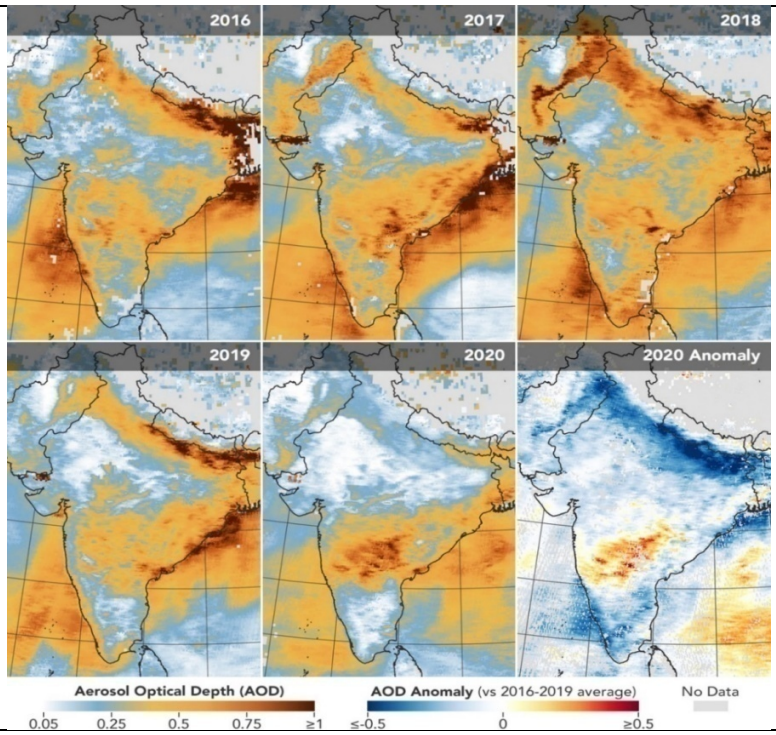
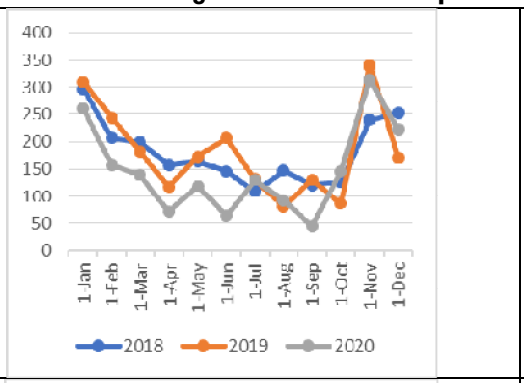
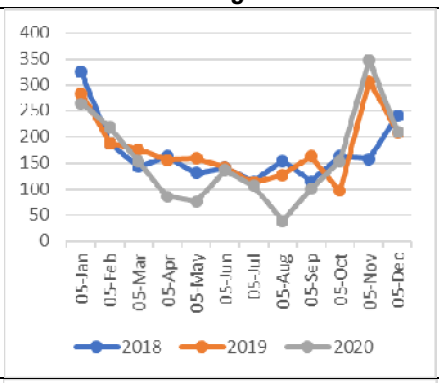
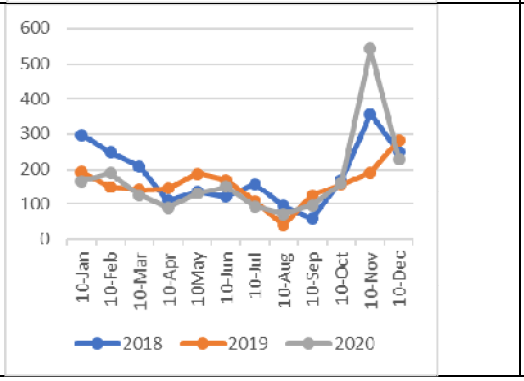
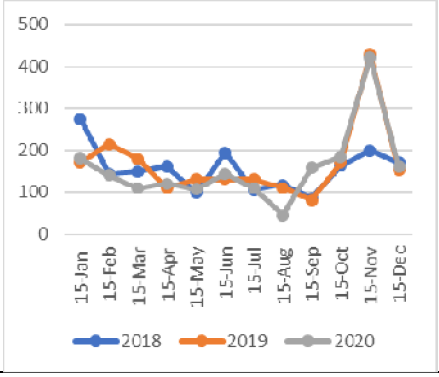


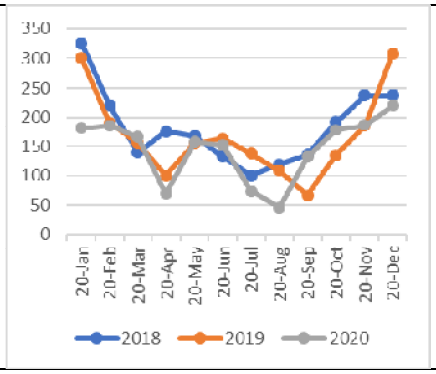
Fig 1: Aerosol levels captured by the NASA satellite images











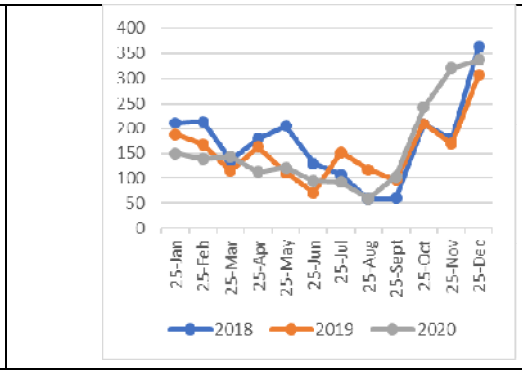
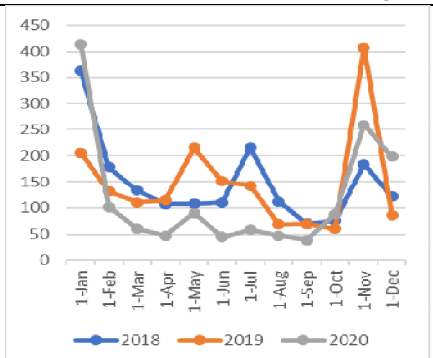
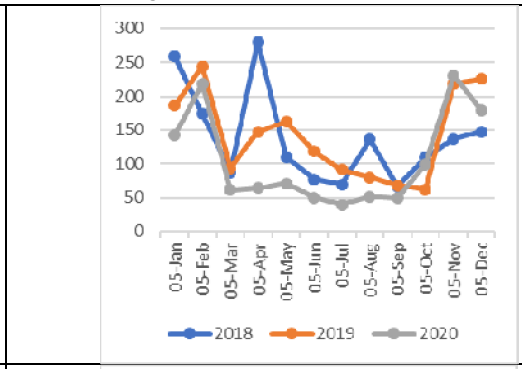
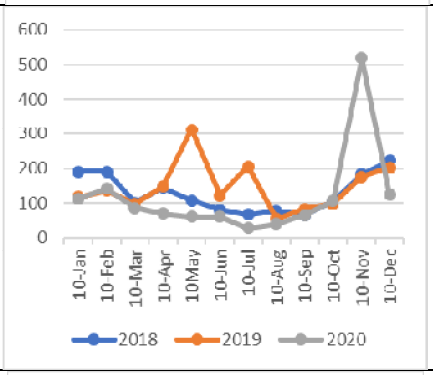
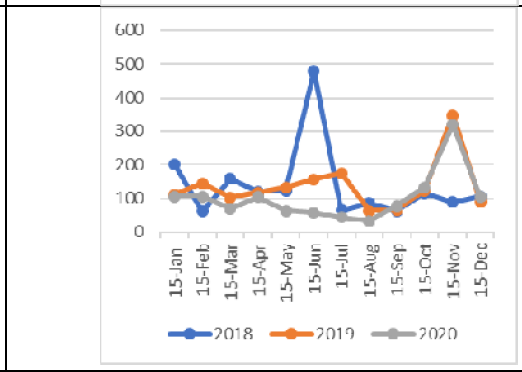


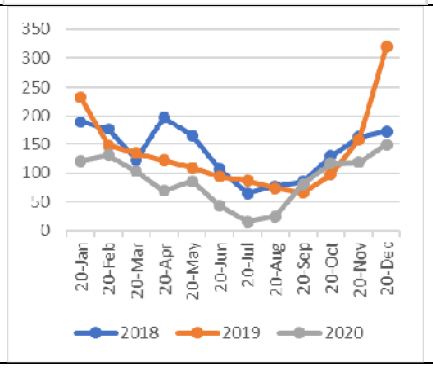
Fig 2: PM2.5 for Delhi City











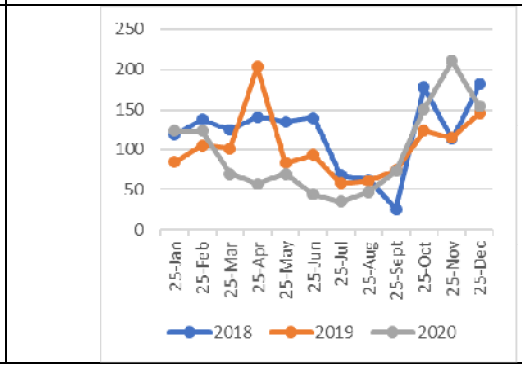


Fig 3: PM10 for Delhi City

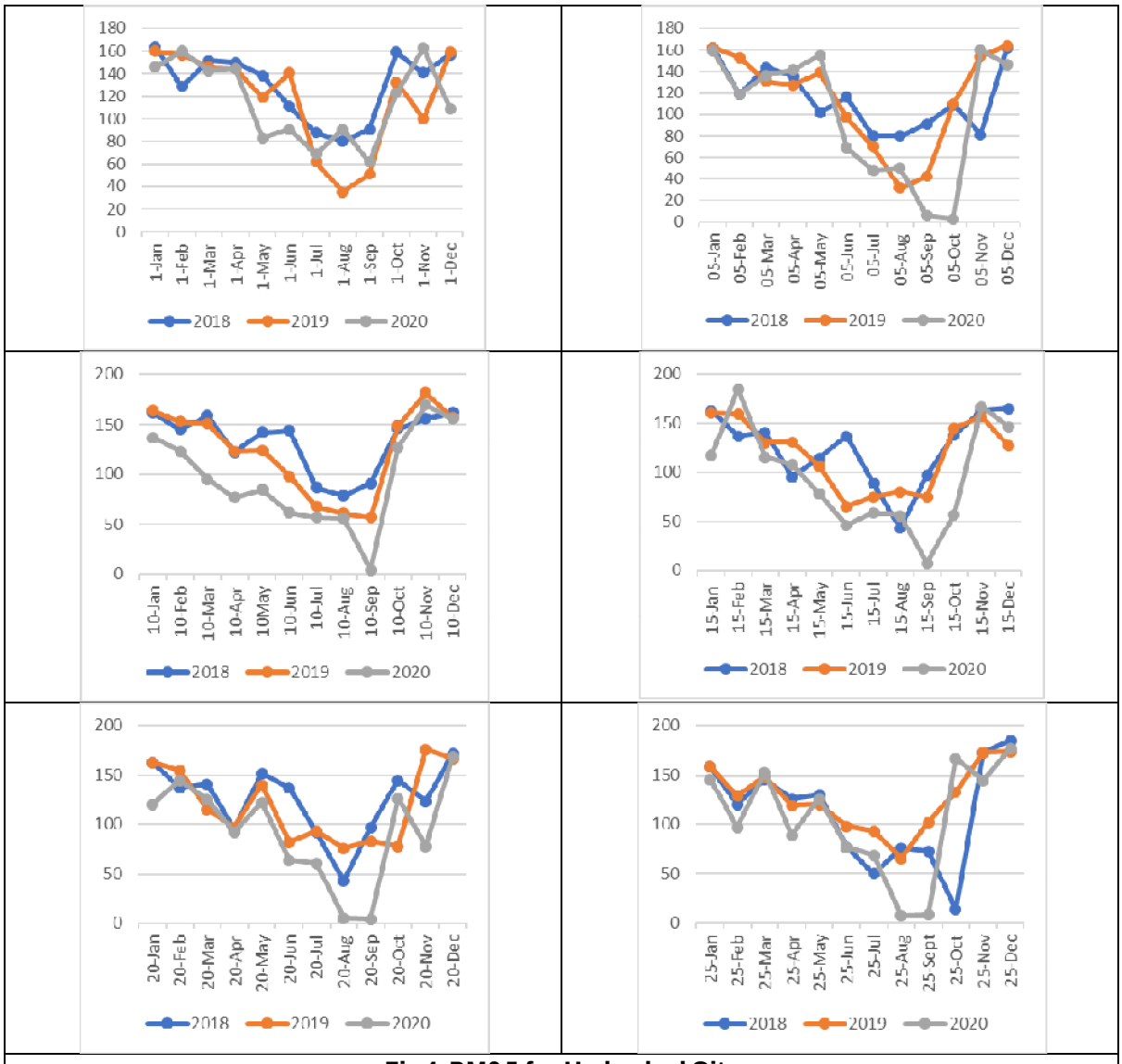


Fig 4: PM2.5 for Hyderabad City

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RESEARCH ARTICLE

An Experimental Study on the Properties of Geopolymer Aggregates -- An Ecofriendly Alternative to Natural Coarse Aggregates

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ABSTRACT

Due to increase of construction activities around the world, there is considerable increase in demand of normal aggregates like granite and gravel which has tremendously depleted the natural stone deposits,thus contributing to inevitable environmental destruction. Even the disposal of industrial wastes such as flyash and slag also results in land and water pollution. In this study, efforts has made to use this industrial byproducts in manufacture of artificial aggregates by adopting geopolymerization technique to make the concrete more environmentally friendly. The geopolymer aggregate properties was studied for various mix ratios of binders, alkali activator concentration and the curing method. The test results obtained shows that the geopolymer aggregates can be considered as a alternative for a natural aggregate.

Keywords: Geopolymerization, Flyash, GGBS, Alkali Activator

INTRODUCTION

Due to the increase of human requirements and infra structural developments there is immense pressure on our resources and environment. There is not much studies happened on the resource extraction and its impact on environment which is a major setback in proper planning and developments. The mining and quarrying are the most disastrous human activities which causes irreparable damages to the living environment. The growth in population and infrastructure development needs of the society, leads to a huge growth in construction activities, which in turn stimulate the stone quarrying operations. The quarrying activities will exert an immense pressure on the water and soil , which in turn effect the hydro-geological and hydrological regimes. In addition to this it also results in dust emission and noise pollution, even the disposal of waste rock in open areas cause diversion of rivers and streams into farming areas which results into the flooding of crop fields[1].The environmental problems due to quarrying

includes noise, vibration and dust pollution, disruption of animal habitats, diversion of natural drainage systems, soil erosion and river siltation and destruction of vegetation .[2,3].

As a result of urbanization and industrialization, there is a huge increase in the generation of industrial waste in both developed and developing countries. This in turn causes serious problems relating to environmental pollution. In developing country like India these byproducts considered as total waste, on the other hand there is a huge demand for raw materials which is results in the swindling of non- renewable resources. Most of the times landfilling is adopted as the disposal method of industrial waste, the disposal areas are not properly chosen considering the geophysical soil properties, hydrogeology, topography and climate which results in the land ,water and air pollution. These pollution issues arising from the disposal of waste can be solved by recycling the min to utilizable raw materials for various beneficial uses. In India about 960 million metric tons of solid waste is being generated annually as the byproducts of industrial, municipal, mining, agricultural and other processes. The concept of solid waste management and use of these industrial byproducts as a alternative building material to the traditional materials has emerged as a ecofriendly solution[4].The major quantity of industrial wastes are produced from the thermal power plants, the Iron and Steel mills non-ferrous industries, sugar industries, pulp and paper industries and allied industries

In concrete about 50 to 70% of volume is occupied by the coarse aggregates which is mainly extracted by quarrying which is damaging the biodiversity and causing a lot of pollution.[5] .As per the Ministry of Power, Government of India, it is estimated that every year 1800 million tonnes of coal used in thermal power plants and by 2030-31 about 600 million tonnes of fly ash will be generated[6]. A lot of research activities are going on for a eco-friendly solution to this problem an alternative to natural aggregates in concrete using these industrial byproducts. Due to increase of construction activities around the world, there is considerable increase in demand of normal aggregates like granite and gravel which has tremendously depleted the natural stone deposits, thus contributing to inevitable environmental destruction.Lightweight concrete has been used by developed nations for many years.This can be ach ieved mainly through the use of lightweight aggregate (LWA)[7]. The use of artificial aggregates in concrete which developed with fly ash as a raw material will solve the problem of environmental degradation by the effective utilization of flyash. The artificial lightweight aggregates can be produced from other industrial by-products such as fly ash, bottom ash, blast furnace slag, silica fume, rice husk ash, or sludge waste or palm oil shell, shale, slate, clay.[8] .The partial or full replacement of concrete constituents not only reduce the construction cost but also results in recycling of industrial waste towards the sustainable environment. These artificial aggregates has comparable strength properties that of conventional.

Investigations were started in the field of alkali activated materials from the year 1978 after J.Davidovits,[9] developed and patented binders obtained from the alkali-activation of metakaolin and called it as “geopolymer”. The geopolymer synthesis is based on the reaction of aluminosilicate materials with an alkali metal hydroxide and an alkali metal salt and formation of a three-dimensional inorganic amorphous structure. The geopolymer green-chemistry helps in generating new types of low-CO_2 cements from industrial waste-materials such as coal fly-ashes, coal-mining waste, etc for building and infrastructure applications. P. Gomathi et.al.[8] investigated the production of alkali activated aggregate with different binders such as metakaolin, furnace slag and bentonite. The strength and gradation of activated fly ash aggregate depends on the type and dosage of binders ,speed of disc , angle of disc, and duration of pellet formation. Mustafa Al Bakri [10] studied the effect of various molarity of NaOH(6, 8, 10, 12, 14, and 16 M in geopolymer paste was studied. The samples were cured at 70°C for 1 day and, with 12 M NaOH solution shows high compressive strength.

Geopolymer Aggregates

The molarity of the NaOH solution plays a vital role in strength development in geopolymerization reaction. It is observed from the researches that increase of alkalinity of the solution improves compressive strength but beyond 10 M no significant improvement in the mechanical property[11]. The alkali activators helps to speed up the

dissolution of aluminosilicate in the solution. Higher concentrations of aluminosilicate species are released into solution with faster dissolution rate. The geopolymerization rate increases with rapid destruction of GGBS and also the high sodium hydroxide concentration reduces the induction period [12]. Ramamurthy K [13] in conducted study on manufacturing of geopolymer aggregate with Flyash and GGBS activated with alkaline solution and cured at temperatures between 50 and 80^0 C for a period of 24 to 48 hours .The several studies were also conducted on the geopolymer cement and concrete using low calcium fly ash [14]. In Low-calcium flyash was chosen as a source material over high-calcium fly ash high calcium content interfere the polymerisation and modify the microstructure [15] .Studies show that the geopolymer formed by curing at ambient temperature has similar properties to those cured in oven other than the strength, higher strength for oven cured geopolymer concrete. The alkali activation is used for the manufacturing of geopolymer aggregate cured at ambient temperature[16].

Manufacturing of Geopolymer aggregates: The geopolymer aggregates are produced by the alkali activation of industrial waste materials such Flyash and GGBS. The amount of geopolymer solids present in the mixture is the sum of mass of GGBS, fly ash and solids present in the sodium silicate solution i.e. the mass of SiO_2 andNa_2O. A combination of sodium silicate and sodium hydroxide solution is used as alkali activator solution. The liquid to geopolymer solids ratio has been kept as 0.3 and the sodium silicate to sodium hydroxide ratio is maintained as 2. In a 50-litre capacity laboratory concrete mixer flyash and GGBS were first mixed together for5 minutes. The alkaline solution is added to the mixture in small quantities and continued for further 10 minutes. The aggregates were formed at the end of the mixing were transferred into a pan for green curing. Aggregates were manufactured for varying concentration of sodium hydroxide as well different ratios of flyash and GGBS. The concentration of NaOH solution is varied from 8 M to 12 M and flyash and GGBS is also taken in different ratios for the study. The flyash was procured from Raichur Thermal power plant and the GGBS was procured from JSW steel plant Bellary. The alkaline liquid used was prepared by mixing Sodium Silicate solution (Na_2SiO_3) and Sodium Hydroxide (NaOH) solution in required amounts. The alkaline activator solutions is used to activate the source material such as class F fly ash and GGBS. The study has conducted on aggregates produced with varying concentration of sodium hydroxide solution in the range of 8 and 12 Molar. The flyash and blast furnace slag was used as source material in different mix ratios. The aggregates thus produced using a concrete mixer were cured at ambient temperature of 25+/-2^0C. The micro-structural studies such as X-ray diffraction and SEM analysis was conducted ongeopolymer aggregates to analyze the phases formed due to geopolymerization.

Mix proportions of Geopolymer Aggregates: The Geopolymer Aggregates were produced for varying ratios of Flyash and GGBS as in table.1. The study has conducted for manufacturing of geopolymer aggregates for three different mix combinations of flyash and GGBS .Five different proportions of Flyash and GGBS of were considered for the study. The concentration of sodium hydroxide in the alkali activator solution is varied from 8 Molar to 12 Molar.

RESULTS AND DISCUSSIONS

Aggregate crushing strength of geopolymer aggregates (GPA): The test results obtained from the aggregate crushing strength of geopolymer aggregates (GPA) for varying concentration of NaOH and different ratios of GGBS and Flyash were plotted in fig.2. The aggregate crushing value of all the mixes obtained are within the permissible value of 30% as per IS 383: 2016.There is a reduction in aggregate crushing value with the increase in concentration of NaOH solution was observed.

Aggregate Impact value of Geopolymer aggregates (GPA): The aggregate impact value is considered as a measure of the resistance of aggregate to the sudden shocks or impact. The test was conducted in accordance with the method specified in IS 2386 (part 4) and as per IS 383: 2016 the impact value should not exceed 30%. From the, graph was plotted as in fig 3, the impact value decreases with an increase in the concentration of sodium hydroxide

as well as the percentage of GGBS in the aggregate Since there is no appreciable strength gain is obtained after 12M NaOH solution further studies were conducted with three different concentration of sodium hydroxide solution 8M,10M and12M.

Specific gravity of Geopolymer Aggregates: The specific gravity mainly depends on the density of the aggregates. It is observed from the graph plotted as in fig 4, an increase in the specific gravity of geopolymer aggregates with the increase of GGBS percentage. The specific gravity of flyash is lesser than that of GGBS, which is also reflected in the geopolymer aggregates produced , but there is not much appreciable change in specific gravity beyond 50% of GGBS in the mix .Even the concentration of NaOH has a little effect on the specific gravity. The geopolymer compound formed with higher percentage of GGBS is found to be more denser than that with flyash which increases the specific gravity of GPA3 aggregates compared with GPA1.The 100% GGBS mix also have a similar value that of GPA3 and GPA2 aggregates with higher concentration of sodium hydroxide.

Water absorption of Geopolymer aggregates: Generally the artificial aggregates has high water absorption property due to its porous nature. As per IS 383:2016 upto 10% is permitted for recycled aggregates **.** It is observed that water absorption decreases with increase in the Sodium hydroxide concentration. The increase in NaOH concentration reduces the porosity of aggregates and thereby reducing the water absorption. Also the mixes with high percentage of flyash shows higher water absorption due to porous geopolymerization compound. From the fig 5, shows similar pattern for all the 3 mix ratios and after 50 % addition of GGBS to the mix there is a reduction in the water absorption rate. There is no considerable increase in the strength beyond 12M NaOH solution, also for lesser concentration of 10M the aggregate strength obtained is within the limits and comparable with the values obtained for higher concentrations of sodium hydroxide. So the 10M NaOH is considered as the optimum concentration for the further study.

Gradation of Geopolymer aggregates: After pelletization the aggregates were kept for curing at ambient temperature for a period of 7 days .The aggregates produced after curing is sieved and which is passing through 20mm sieve and retained on 4.75mm sieve was collected. Fig 6 shows the gradation curve of geopolymer aggregates GPA2 and GPA3 of 10 M NaOH concentration. Out of the three types of geopolymer aggregates GPA1 aggregates has poorly graded when compared to the other types GPA2 and GPA3 as per IS 383:2016. For GPA1 only 80% aggregates are retained between 20mm and 10mm sieve which is much less than the required. In the case of GPA2 and GPA3 around 90% of aggregates were retained in between 20mm and 10mm sieve which shows the effective pelletization of aggregates. The fineness modulus of all the three types aggregates are in the range of 6.5 to 7.00 which is within the permissible limit. There is no considerable increase in the strength of geopolymer aggregates beyond 12M NaOH, also for 10M concentration the values are comparable with the values obtained for higher concentrations of sodium hydroxide. So the 10M NaOH is considered as the optimum concentration for the further study.

SEM and XRD Analysis: The microstructural studies such as SEM and XRD analysis conducted on the geopolymer aggregates of optimum mix that is GPA3 mix. From the SEM images and diffractograms noticed the formation of geopolymer compounds such as calcium silicate hydrate (CSH), calcium aluminate hydrate (CAH), and calcium aluminate silicate hydrate (CASH) which increases the strength of the material .The SEM images also shows the formation of geopolymer compound with increase in the alkaline concentration and GGBS content in the mix which is directly affecting the strength formation of aggregates. It is observed from the XRD diffractograms that aluminosilicate compound of different chemical structure is formed as a result of geopolymerization. So formed geopolymer compound has chemical formula which resembles to different types of silicate rocks which is the hard in nature. Mainly inosilicates rocks combinations are observed which consists of single chain structure of SiO_4 tetra hedraclinopyroxenes and double chain structure of amphiboles were observed.

CONCLUSION

The geopolymer aggregates were manufactured using varying proportions flyash, GGBS and alkali activators with geopolymerization technique. Based on the studies conducted, the geopolymer aggregates has the mechanical properties comparable with natural granite aggregates. .It is observed from test results obtained that GPA 3 aggregates has achieved better strength parameters when compared to other mix ratios and considered as the optimum mix for the geopolymer aggregate production. The strength of geopolymer aggregates increases with increase in the concentration of sodium hydroxide. After 10M NaOH there is no appreciable strength development is noticed, so the sodium hydroxide of 10M concentration is considered as optimum for the study. The strength of the geopolymer aggregates is increased with increasing percentage of GGBS in the mix. Even there is a decrease in the water absorption due to the formation of denser geopolymer compound. The geopolymer aggregates of GPA3 mix ratio has considered as the optimum mix proportion to produce artificial aggregates having similar properties as that of natural aggregates. Even at ambient curing conditions also geopolymer aggregates has attained the required strength. In SEM image and XRD pattern of GPA3aggregates shows the formation of denser geopolymer compound which reflects similar strength properties of natural rocks. The geopolymer aggregates can be considered as an alternative for natural coarse aggregates .By recycling the industrial by products as a source material, also reduces the impact on the environment due to their disposal .

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Table 1. Mix proportions of Geopolymer Aggregates

Geopolymer Aggregates	Mix ratios of Flyash : GGBS	Concentration of NaOH Solution (M)			
GPA1	75FA:25GGBS	8	10	12	16
GPA2	50FA:50GGBS	8	10	12	16
GPA3	25FA :75GGBS	8	10	12	16
GPA4	100FA:0GGBS	8	10	12	16
GPA5	0FA:100GGBS	8	10	12	16

Fig 1: Geopolymer aggregates

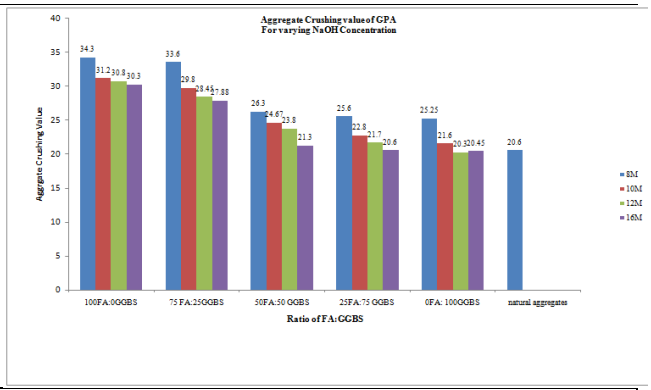

Fig 2: Aggregate crushing strength of GPA

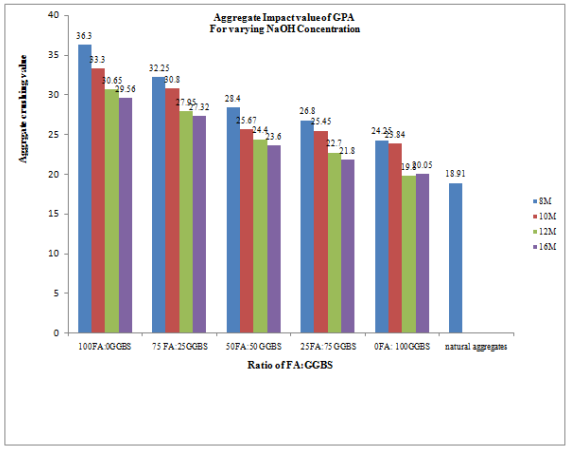

Fig 3: Aggregate Impact strength of geopolymer aggregates(GPA)

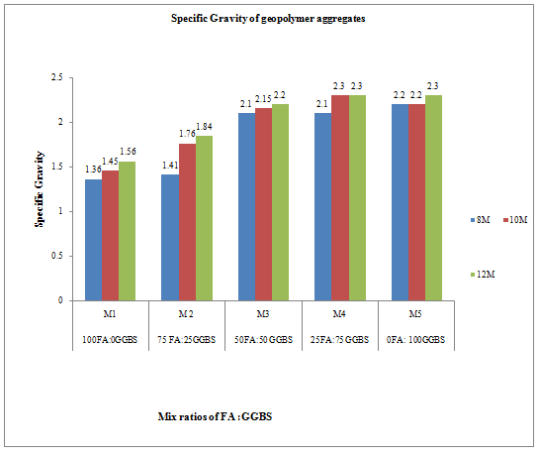

Fig 4: Specific gravity of Geopolymer Aggregates

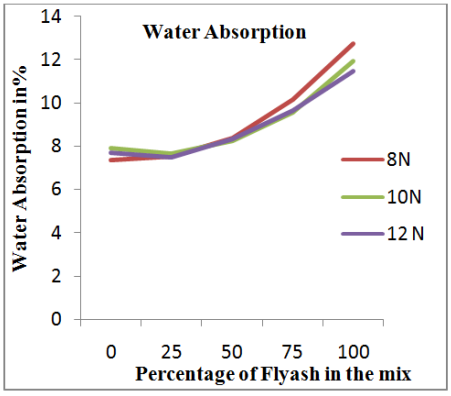

Fig 5: Water absorption of Geopolymer aggregates

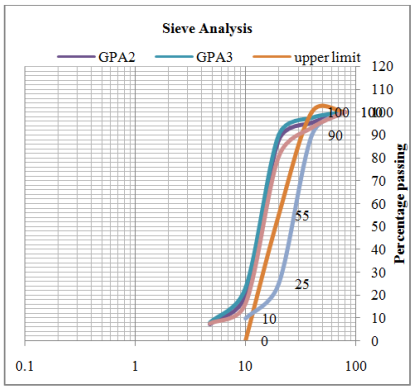

Fig 6: Gradation curve of geopolymer aggregates

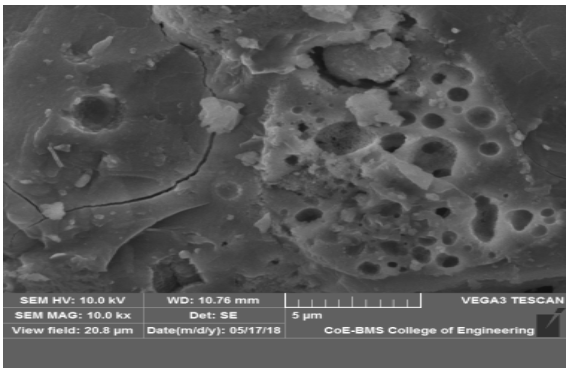

Fig 7: SEM image of GPA3

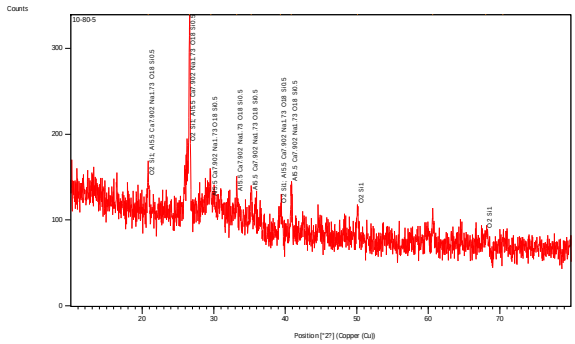

Fig 8: XRD pattern of GPA3

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RESEARCH ARTICLE

Mathematics of Coalescence

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ABSTRACT

In genetics, the term 'coalescence' refers to the merging of genetic lineages backwards to a most recent common ancestor. In this paper I describe the coalescence of lineages as we move backwards in time within a single population. Time will be denoted by u, from the present with $u = 0$ into the past with $u > 0$, and is measured in coalescent units. In the model presented in this paper, I make two important assumptions and derive two important results. In particular, I proved that expected time until all lineages coalesce is 2.

Keywords: Coalescence, Independent and Identically Distributed (iid), Expected time of coalesce, Bottleneck model, Coalescent tree.

INTRODUCTION

When DNA or other sequences are collected, they come from individuals of a taxon, and not the taxon as a whole. Moreover, the sequence is not the entire genome of the individual, but more typically the sequence of one gene. Thus the trees we find should represent the evolutionary relationships of these individual genes or loci, and are better called gene trees. These trees need not represent the evolutionary relationships of the full taxa, or even of the full individual. It is possible that they represent the relationships of the taxa on a species tree, and under some circumstances it is even likely. However, it is also quite likely that the gene trees and species trees will be in conflict.
The model used to capture incomplete lineage sorting is the multispecies coalescent. It modifies Kingman's basic coalescent model of population genetics so that several populations are linked to form a tree. Although this modeling framework is now fairly well established, it is not yet clear what methods of species tree inference inspired by it will ultimately prove most useful. Thus any enthusiasm or criticism we offer of particular approaches should be taken lightly; more progress can be expected in the next few years.

Description of the Model

To begin with I make the two following assumptions for discussing the model:

Given pairs of lineages at any fixed time, the rate at which pairs coalesce into single lineages is constant, and equal to 1. Simultaneous coalescence of more than two lineages does not occur. Coalescence of different pairs is independent, and identically distributed (iid).

With these assumptions, I describe the coalescence model as follows:

Consider two lineages which are distinct at time 0, and $u > 0$, let $h(u)$ denote the probability that the two lineages are distinct at time u (that is, the two did not coalesce between time 0 and time u). Then we get

$$\frac{d}{du}\big(h(u)\big) = -h(u) \quad (2.1)$$

where the negative sign is due to the fact that $h(u)$ is a decreasing function. Since we additionally know that $h(0) = 1$, the solution of (2.1) by variable separable method is given by $h(u) = e^{-u}$ (2.2).

Thus if $P(u)$ denotes the probability the two lineages did coalesce between time u_0 and u, we have

$$P(u) = 1 - e^{-u} \quad (2.3)$$

From (2.3), we have $P'(u) = e^{-u}$.

I now compute the expected time to coalescence of two lineages. Since the probability of coalescence in a short time interval is $P(u + \Delta u) - P(u) \approx P'(u)\,\Delta u$ (2.4), the expected time is given by

$$E\left(P'(u)\right) = \int_0^\infty uP'(u)\, du = \int_0^\infty ue^{-u}\, du = 1 \quad (2.5)$$

That this expected time to coalescence does not depend on the size of the population should seem surprising. However, as defined here the coalescent model ignores the population size it is never even referred to in the definition of the model. I have simply defined the time scale so that the rate of coalescence is one.

Analyzing with population size

In the previous section, in equation (2.5), we observed that the expected time to coalescence does not depend on the population size. But the fact is that the population size does matter, but it is taken care of by the definition of coalescent units. To see why this is so, I offer the following explanation.

Imagine that the population size changed as we move backwards in time, forming a bottleneck, as in Figure 1, which depicts a model with population size $N_1 = 10$ except for $m_2 = 9$ generations with population $N_1 = 4$. The bottleneck causes faster coalescence of lineages, producing similar behavior to a longer time span with no bottleneck. If the large population below the bottleneck is N_1, coalescence of pairs of lineages occurs with probability $1/N_1$ in each generation. When lineages enter the bottleneck, the same formula applies, but with a smaller population size N_2, the probability is now larger, $1/N_2$.

Thus coalescence becomes more likely to occur. This means that if we had no access to the generational time scale, and could only query whether coalescence had occurred, the bottleneck of a relatively small number of generations of size N_2 would be indistinguishable from a larger number of generations where the population had remained constant at size N_1. I now prove an important theorem regarding coalescence.

Theorem 1
The expected time until all lineages coalesce is 2

Proof: To determine the expected time until all lineages coalesce, I first determine the expected time to coalescence of *n* lineages down to one. For all *n* lineages to coalesce, first 2 must coalesce so only *n* – 1 lineages remain. Then 2 of these must coalesce so only *n* – 2 remain, and so on, until the last 2 coalesce. When all *n* lineages are present at time $u_0 = 0$, there are many pairs that might coalesce. It is thus reasonable that the first coalescent event will occur sooner than if only two lineages were present.

Now for determining the expected time of coalescence from *n* to *n* – 1 lineages, we can make use of the iid assumption of coalescence of different pairs, so that the overall rate of coalescence is increased by a factor of $\binom{n}{2} = \frac{n(n-1)}{2}$ number of pairs.

Thus if $k(u)$ denote the probability that *k* lineages remain distinct at time $u > 0$, then we have

$$\frac{d}{du}\left(k(u)\right) = -\frac{n(n-1)}{2}k(u) \quad (4.1) \text{ where } k(0) = 1 .$$

Solving the first order differential equation by variable separable method, the solution to (4.1) is given by

$$k(u) = e^{-\frac{n(n-1)}{2}u} \quad (4.2)$$

Now, if *P*(*u*) denotes the probability the *n* lineages did coalesce between time u_0 and *u*, we have

$$P(u) = 1 - k(u) = 1 - e^{-\frac{n(n-1)}{2}u} \quad (4.3)$$

From (4.3), we get $P'(u) = \frac{n(n-1)}{2}e^{-\frac{n(n-1)}{2}u} \quad (4.4)$

Now expected time for *n* lineages to coalesce to *n* – 1 is $E\left(P'(u)\right)$ which from (4.4) is given by

$$E\left(P'(u)\right) = \int_0^\infty uP'(u)\,du = \int_0^\infty u\,\frac{n(n-1)}{2}e^{-\frac{n(n-1)}{2}u}\,du = \frac{n(n-1)}{2}\int_0^\infty u\,e^{-\frac{n(n-1)}{2}u}\,du$$

Using Integration by parts, we get

$$E\left(P'(u)\right) = \frac{n(n-1)}{2}\left[(u)\left(-\frac{2}{n(n-1)}e^{-\frac{n(n-1)}{2}u}\right) - (1)\left(\left(-\frac{2}{n(n-1)}\right)^2 e^{-\frac{n(n-1)}{2}u}\right)\right]_{u=0}^{\infty}$$

$$= \frac{n(n-1)}{2} \times \left(\frac{2}{n(n-1)}\right)^2 = \frac{2}{n(n-1)} \quad (4.5)$$

Hence from (4.5) the expected time for *n* lineages to coalesce to 1 is given by

$$\sum_{r=2}^{n} E\left(P'(u)\right) = \sum_{r=2}^{n} \frac{2}{r(r-1)} = 2\sum_{r=2}^{n}\left[\frac{1}{r-1} - \frac{1}{r}\right] = 2\left[\left(1-\frac{1}{2}\right)+\left(\frac{1}{2}-\frac{1}{3}\right)+\cdots+\left(\frac{1}{n-1}-\frac{1}{n}\right)\right]$$

$$= 2\left(1-\frac{1}{n}\right) \quad (4.6)$$

Thus to determine, the required value, we need to consider the limit as $n \to \infty$ in (4.6).

Doing this, we find that the expected time until all lineages coalesce is given by

$$\lim_{n\to\infty} \sum_{r=2}^{n} E\left(P'(u)\right) = \lim_{n\to\infty} 2\left(1-\frac{1}{n}\right) = 2 \quad (4.7)$$

This completes the proof.

CONCLUSION

Introducing the concept of coalescence and developing a suitable model I proved two important results in this paper. In particular, in section 3, while analyzing with population size, using the bottleneck model, I proved that coalescence is more likely to occur. Moreover, from (4.5) we find that the expected time for 2 lineages to coalesce to 1 is 1 unit, the time for 3 to coalesce to 2 is only 1/3 unit, the time for 4 to coalesce to 3 is 1/6 unit and so on. Thus the expected time for larger number of lineages to coalesce with previous number becomes smaller and smaller of the unit of coalesce. In (4.7), I proved that the expected time until all lineages coalesce is 2. Notice that this value is just twice that of when $n = 2$ obtained in (2.5).

Finally, these calculations indicate that in a typical coalescent tree formed by a large number of lineages coalescing we should expect to see a lot of coalescence near the leaves of the tree, and longer edge lengths near the root. Roughly half the tree will have only two lineages which coalesce at the root, one third will have 3 lineages, etc. These characteristics are depicted in the tree shown in the following figure 2. Thus using simple model where I had used only first order ordinary differential equation, I had proved two significant properties regarding coalescence in this paper. By considering various other assumptions we can come up with other set of differential equations, whose solutions might offer new insight in the study of coalescence.

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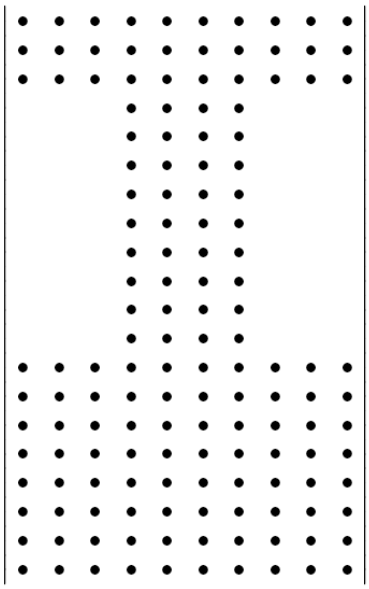

Figure 1: Bottleneck version of populations in coalescent model

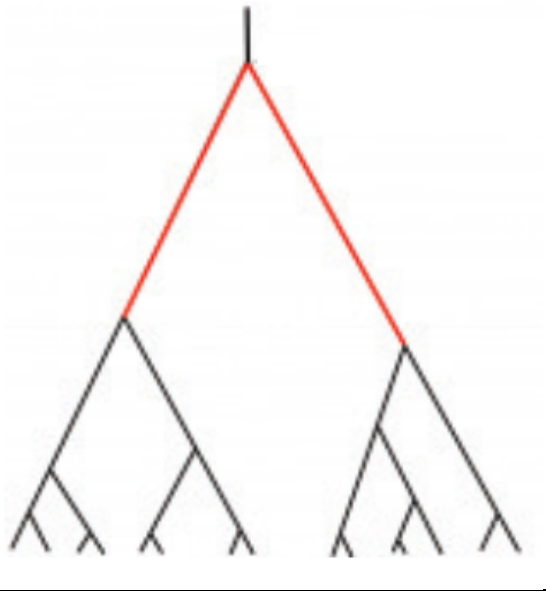

Figure 2: Structure of Coalescent Tree

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RESEARCH ARTICLE

Monitoring of Temperature, Humidity of Weather Prediction Based on Machine Learning

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ABSTRACT

In this paper, we will able to know/analyze about the temperature of weather in different conditions and timing in all around the world, mainly in INDIAN SUBCONTINENT using Machine Learning approaches. The Data have keep by the government website to analyze the data for few long years. By the UCI technique this data should be matched, for the Machine Learning and obtain the condition of the different level of data repository. The Different parameters have been taken to monitor the different weather conditions, temperatures and humidity. The conditions were also analyzed by these parameters to fit the different conditions, we need to design a model, and also to extrapolate the requirement of information, and optimize the technique using some algorithm and variations. It should be targeted and value must be analyzed.

Keywords: Weather monitoring; weather prediction; machine learning Algorithm networks; ANN.

INTRODUCTION

In daily life, correct weather forecasting is essential for human life. We are heavily dependent on weather forecasting, from agriculture to industry, from travelling to daily commuting and more. The weather conditions are changing around the world rapidly and continuously. Quality agriculture relies on gathering comprehensive weather conditions, which includes different parameters such as: temperature, humidity, etc. Suffering from above these parameters due to continuous climate changes and its side effects to the entire world. It is very important to predict the weather conditions without any error to ensure easy and seamless mobility, as well as safe day to day operations.

Climatic Changes is the main issue that we are facing now a day, which turn around the world. We need an accurate forecast to fix the daily life smooth. We have to need focuses on the issues mainly on Agriculture, Fishing and industry need to concentrate more on weather forecasting.

The accuracy is more sufficient we know by the Prediction through machine learning, it plays an important role to ensuring the accuracy. Weather monitoring is main issue of Daily life, if we predict correctly the agriculture, fishing improve their income high. We can use different level of instruments for higher level of classification rate for them we need to do forecasting models. Most of our daily tasks are generally dependent on weather patterns and knowing the weather patterns becomes a great demand for cultivation and even for general public. it would become much easier for all people, that one could predict the future weather patterns at a very early stage. In our model we used the dataset and remove the noise in the data, preprocess it to find the best suitable values.

Machine Learning Algorithms

One of the principle advantages of acquainting AI with climate anticipating is more precise expectations. AI can be utilized to handle quick examinations between recorded climate figures and observations. With the utilization of AI, climate models can all the more likely record for forecast mistakes, like overestimated precipitation, and produce more exact expectations. The Machine learning algorithms when it is in using, Data analysis becomes a key role with this. Dataset is taken for the past years in this research work, analyzed and the various Machine Learning algorithms are used in order to obtain the best fit for result.

Linear Regression algorithm

We can write the algorithm and it gives on and off state where it represents the 0 and 1 value for the higher and the lower order of the temperature and humidity level of the different condition values by the data set , In other words Dataset is key in which all the features are present. To classify the weather we need to monitor each day and for classify the weather the technique regression in terms of linear is not used. Not widely for classifying the data sets by the, linear regression techniques. For greater accuracy, Linear Regression algorithm needs to sample more data.

Functional Regression

Functional regression is another algorithm also there for analysing of the data. The condition of historical weather can be monitored and analysed depending on the various parameter taken from the government websites performed by the Functional regression. The weather pattern daily as part of day to day life we need to analysed, and then it predicts the condition of the weather it should using linear regression and estimates the predictive model to get the future temperature data be matched with different level of patterns. The patterns analyzation become easy by depending upon the changes in the reading, it may be considered the historical value for analyses.

Literature survey

Both regression types as linear and functional performance condition is not good, it discussed by the Mark H., Dylan Liu, Christopher V (2016), in the different analysis taken from the professional level they considered. Different methodologies analysed by them, used in the weather level forecasting to analyse their performance is up to mark and getting decreased and performance should be monitored regularly need to be time level maintain should be high. Machine/Deep learning can be attained professional as well as traditional types of methods, needs more longer time, and to outperform their performance. The level is linear regression biasing low and high variance algorithm and hence, while collecting further data its accuracy must should be high.

The worked by P. Kapoor and S. S. Bedi (2013) towards the matching of the pattern by using the techniques of sliding algorithm with some variations in the pattern as window algorithm. In the season the changes can be happen due to every level of changes. Thus result should be taking of how much window level should be change their size. Level needed for measure more time taken for months level contribution towards the increase the size within a month

Research Objectives

In this way, our research is focus to solve some of the issues related to One of the principle advantages of acquainting AI with climate anticipating is more precise expectations. AI can be utilized to handle quick examinations between recorded climate figures and observations. With the utilization of AI, climate models can all

the more likely record for forecast mistakes, like overestimated precipitation, and produce more exact expectations. In specific, the research objectives are as follows.

- Designing of human friendly AI, climate recognition system which will help to classify the information by using machine learning techniques..
- To publish the research work for information dissemination to the computer or researchers and different kind of organizations.

The Proposed Model

One of the main benefits of introducing machine learning to weather forecasting is more accurate predictions. The method used as new techniques is: Linear aggression in which we are predicting the different level of temperatures with on and off switches as 1 and 0 and it should be combination of linear level of changes to all level of features to the required condition. Classification techniques should not use as the parameter of temperature and weather level of changing accordingly and classify the data where the control algorithm is used. We need to change high and low level of conditions to change through the different temperature changing level should be attained. Regression algorithm is the functional level of algorithm in which the historical representation of the pattern changing to the day to day life with variation in the pattern level it should be humidity and temperature as the indicating parameter, it should predict the future level of condition changes accordingly to data taken as historical pattern in which we should matches the patterns level. The data should be train the 80% of data values and remaining 20% for testing in which neural concepts is used.

RESULTS AND DISCUSSIONS

In this manuscript, MATLAB IDE is used for implementation of this work. The neural network is being used to estimate the data values after the development of regression models. First the Dataset is being loaded in the IDE. Then data clearing operation is being carried out in order to obtain the normalized dataset. Then the neural network model is being added and is being tested for the best evaluation results. The second step is to add the Machine Learning algorithm. The data is being calculated over a number of iterations and the future data values is being calculated which the output is. The evaluation performance of the research work is obtained by the calculated order of the evaluation graph and the regression graph. It is seen that the best fit algorithm is only being used and the performance is perfect as regard with the MATLAB executed code. A website was created by Net-Beans software in Java programming language and bootstrap to create the HTTP interface. To load the existing database values and machine learning algorithms an SQL Database is used along with Data analytics was used to predict the future weather data values. For all the users of the website an initial setup was made to just view the forecast data and the past values as well. If in case of any emergency, like occurrences of natural calamity then the user can change the values using the add header included in the web application.

CONCLUSION

The proposed method of approaching is a valuable approach, the Website has various pages including Forecast page, Data Page, Add page, Login page. All the people take access by the Forecast page, is to in order to view the existing as well as the future year's weather data. By entering the year which is to be known on the Input value, the forecast values appear and thus the Annual and Monthly minimum and maximum temperatures will be known. All the available dataset values with real time data as well as forecast readings are the list of Data page. To change the values is used Add page, in case of any natural calamity and the readings are little mismatched. Once changed, the readings are automatically calculated with the future values. To go in Add page and Data page login page is used get access in them.

In this method it is found that big amount of dataset can be easily trained and tested to recognize the different handwritten characters. Now in daily life, this kind of approached is very useful. Future work can be developing the algorithm better segmented techniques. So there is a scope of improvement in the techniques.

Following are the research objectives to be carried out in upcoming period for AI Climate recognition system.

- Designing such system is helpful to identify and recognition the Climate recognition with the help of machine learning approach of AI.
- Publication of the research work in suitable journals and agencies and Organization of conferences.

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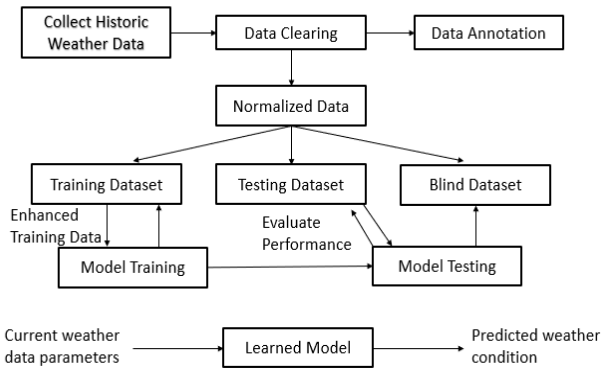

Figure 1 : Architecture of Proposed Model

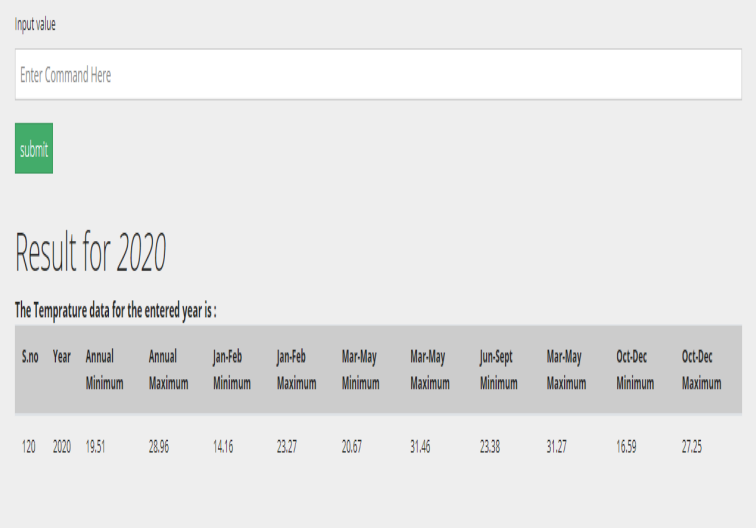

Figure 2: Output of MATLAB

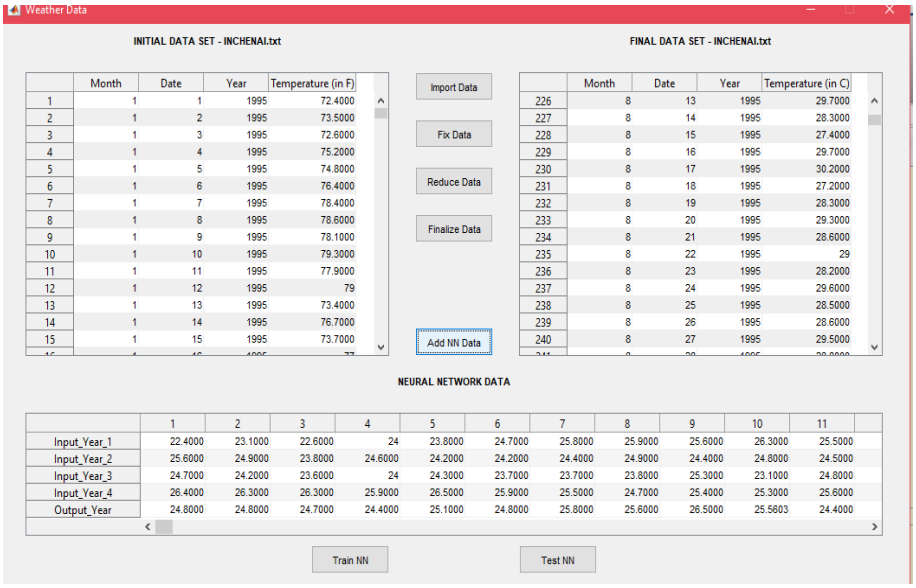

Figure 3:- Experimental Analysis and Discussion (Output of Website)

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REVIEW ARTICLE

A Review on Environmental and Economical Implications of Corrosion

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ABSTRACT

The efficiency and effectiveness of any firm is mainly based on the operating conditions of the equipment and processes at large. The major problems faced by the industries worldwide are related to corrosion regardless of the nature and size of the industry. The corrosion process leads to loss because of the equipment degradation which in turn leads to breakdown of the plant affecting the operations of the firm. Innovations in technology offer a broad range of process to overcome unfavorable consequences. The current review article focuses on corrosion, impacts of corrosion, types and methods of preventing corrosion with a special focus on the economic and environmental considerations of corrosion.

Keywords: Economic, environmental, impacts of corrosion, corrosion, prevention

INTRODUCTION

Corrosion can be termed in several manners. A few among them descriptions are extremely narrow in nature and focus on a particular type of corrosion, where as others are fairly wide and deal with several types of corrosion. The term corrode is originated from the Latin word 'corrodere', which denotes "to gnaw to pieces". The common description of corrode is to wear away slowly. Thus, corrosion may be termed as a chemical or else an electrochemical reaction taking place among materials, generally a metal and its surroundings that which results in deterioration of the material as well as its properties [1]. Corrosion is a normal event, analogous to that of water flowing to the lowest level; every natural process tends in the direction of the least probable energy conditions. Thus, for instance iron and steel have a normal inclination to mix with other chemical constituents to revisit to their least energy states. In order to facilitate return to least energy conditions, iron as well as steel frequently combines with oxygen and water, both of these exist in normal atmosphere, to produce hydrated iron oxides, identical in chemical constituents to the original iron ore. Corrosion can result in malfunctions of plant infrastructure and devices which

are typically expensive to fix, expensive with regards to polluted product, with respect to environmental destruction and probably expensive in terms of human security [2]. The process of corrosion is the harmful attack of a metal by chemical or an electrochemical reaction with its surroundings. Deterioration due to physical grounds is normally not termed as corrosion, however is expressed as erosion or wear. In few instances, chemical attack is accompanied with physical deterioration. "Rusting" refers to the corrosion of iron or else iron - based alloys along with production of corrosion products comprising mainly hydrous ferric oxides. The nonferrous metals, thus corrode, but will not rust [3].

Impacts of corrosion on different spheres of life

The above figure depicts the effects of corrosion on different fields; it is obvious that it affects the different walks of life at large. It affects the environment, infrastructure, economics which are building blocks of a nation. Environment poses sustainable issues when it is affected by corrosion, similarly the energy and its security is a major concern around the world. Production through sustainable means is the need of the hour, therefore when it is affected by corrosion the problem becomes multifold in nature resulting in a major concern. It is quite clear from above discussions that the impact of corrosion is a major concern and it requires immediate attention to resolve the same [5]. Therefore the focus should be on prevention of corrosion rather than adopting control techniques when the corrosion occurs. Keeping in view the corrosion prevention methods and the significance of the same on the global scale, the different prevention methods are discussed in the sections to follow. Similarly the economic and environmental aspects are of greater significance from long term perspective and therefore require immediate attention for the nations round the globe.

Environmental implications of Corrosion

Environmental pollution includes pollution at all levels namely land, water and air. Corrosion bears impact at all the three levels and therefore assessment at all the three levels is of greater significance and is the need of the hour. Global warming is a serious environmental concern caused due to industrial and commercial activities; therefore assessment of environmental implications of corrosion is crucial under these circumstances. Greenhouse effect, acid rains, and the ozone layer depletion are few of the effects of environmental pollution. The transformation in societal outlook has given rise to international accord and norms with regard to environmental damage. In framework of corrosion, green house gases as well as brown clouds bear a harmful impact on the vehicles, cultural monuments and engineered manufactured goods, in the Euro-region, about 12 billion Euros are lost yearly by weakening of structures [6, 7]. The corrosion impediment methods act as a double-edged tool; they prevent corrosion, however the materials employed in corrosion impediment practices lead to environmental pollution [7].

Some of the other harmful effects of corrosion on the environment are: Damage to oil pipelines that may result in an expensive and hazardous rupture that produces considerable environmental damage, emission of hazardous pollutants from iron corrosion that pollutes the air [8]. Corrosion of oil pipelines masked in the soil has turned into the most serious issue to the oil industry. The soil corrosion is a consequence of differential concentration cells relating oxygen, water and different chemicals in the soil [9]. Majority of the corrosion-linked pollution of the environment may be traced to leakage out of perforated tanks as well as pipelines. Due to increase in the number and length of pipelines for oil, water and gas the number of such contamination could be expected to take place. The corrosion may take place on the either side of the pipeline, however is common on the interior surface [10]. The corrosion associated pollution of the atmosphere is familiar and can have an effect on the health of crops as well as potable water, hence, of wildlife and human beings, then we can expect ''everyday corrosion,'' which produces items, out of household matter to production equipment to highway infrastructure, aesthetically awkward, and potentially harmful [10].

Corrosion can take place everywhere on the pipes that transport potable water, essentially at the place of contact amid two different metals, therefore producing a corrosion cell. Generally, the metal corrodes to a larger or smaller extent in water, based on the type of the metal, on the ionic constituents of water along with its pH [11]. In case of

soil moisture it is likely to contain moist film on the surface of metals, whose aggressiveness based on nature of soil and extent of pollution. Therefore, the soil may form on surface of the metal an electrolyte complex with differing proportion of aggressiveness, a essential part for the development of an underground electrochemical corrosion [11]. In case of corrosion system of metal in the water, the flow rate of solution not only influence the rate of diffusion of dissolved oxygen, however it bears an impact on the corrosion products form of metallic surface which leads in various corrosion rates [12]. Several distribution networks of first-order reverse osmosis product water have severe corrosion impact and produce water emerges brown after long-distance transmission that not only bears an impact on the water quality acutely, however it directly intimidates the security of distribution network [12]. It is evident from the discussions that Corrosion affects the environment in every possible way; hence the prevention methods should be in place at all levels namely water, land and air. There should be a tradeoff between the prevention methods and the cost involved in adopting the prevention methods so that these methods could be adopted in efficient and cost effective manner possible.

Types of Corrosion and Prevention methods

Types of Corrosion

The different kinds of corrosion have a negative effect on the metals at large and results in deterioration. These mechanisms or types are different in nature and the same is dealt in the section to follow:

General corrosion consists of the generally identified rusting of iron or tarnishing of silver. The “Fogging” of nickel and high - temperature metal oxidation belong to this type of corrosion. Normally, for general corrosion, the early corrosion rate is larger than subsequent rates [13]. Galvanic corrosion occurs whenever two different metals are electrically attached in a corrosive solution. The corrosion rate relies on the electrical conductivity of the solution, the variation in corrosion potential of the metals as well as the surface ratio amid the metals [14]. Crevice corrosion is a limited kind of corrosion that can be observed in crevices or regions where dormant solutions exist [14]. Rashidi et al., reported that the energy needed for the corrosion is acquired by the energy liberated by constituents from the upper to lower level [15]. Pitting corrosion is defined as to limiting to a small region by where voids and craters are produced in the metal surface. The parameters that are principally accountable for pitting corrosion are the presence of hostile anionic species and chloride ions [16]. The severity of corrosion differs logarithmically with respect to the chloride concentration [17].

Inter-granular corrosion is a discerning attack in the surrounding area of the grain peripheries. The variation of the grain energy leads to inter-granular corrosion. This kind of corrosion takes place more so at the peripheries of crystallites of the metal compared to their interior surfaces. The major reason for this type of corrosion is because of the lessening of chromium mixed with a different mechanism, which leads to structural variations that result in explicit corrosion attacks [18, 19]. Selective corrosion is detected in alloys where in one component or contamination is obviously less pure compared to the other metal components. The selective leaching is termed as “the elimination of particular constituents of an alloy from the surface apparatus, instigated by feebly bound or solvable constituents or aggressive media” [20]. This is additionally known as selective leaching, de-nickelification, so on, indicating the constituent eliminated [21]. Erosion-corrosion is the mixed result of corrosion and erosion and is produced by the quick movement of any unbalanced fluid on a metallic surface. The corrosion is the mechanism of metal degradation largely because of a chemical or else an electrochemical action. Nevertheless, erosion is entirely mechanical. The mixed effect of these two mechanisms that operate jointly in aqueous atmospheres is identified as erosion-corrosion [22]. Biological corrosion is the major cause for interior corrosion. Bachmann and Edyvean have revealed that the production of colonies of bacteria is the reason for corrosion to occur [23]. The bio-films react with the metallic surfaces and stimulate corrosion, which is generally called as bio-corrosion, which leads to microbiologically stimulated corrosion [24, 25].

Prevention Methods

Organic coatings are extensively employed to safeguard metallic surfaces from corrosion. The usefulness of these coatings relies not only on the properties of the coatings that are associated with the polymeric network and probable imperfections in the network, but furthermore on the characteristics of the metallic substrate, the surface pretreatment along with the application processes [26]. Organic coatings offer safeguard either through development of a barrier action from the film or from active corrosion inhibition provided by pigments in the coating.

Different Types of Corrosion Prevention Methods

Barrier Coatings: There are several mechanisms of anti-corrosion coatings however usually, method of coating can be distinguished as; barrier formation among substrate materials and surroundings, reduction of the corrosion mechanisms and coating serving as sacrificial materials. Nevertheless, of late one among the novel approaches is known as "active-passive". This involves the coating serving as barrier film which does not allow penetration of corrosive materials to the metallic surface [27]. The active method permits the creation of efficient passive film and this hinders the corrosion partial reactions causing Schottky barrier at the periphery leading to reduction of the electrons [28]. The barrier coatings though are efficient when they don't form cracks, pinholes etc. These barrier coatings can subsequently essentially entrap these reactive materials in the vicinity of the metallic surface and allow the corrosion to take place.

Hot-Dip Galvanization: Galvanizing layer initially act as a barrier coating to prevent corrosive agents namely Cl- ions from pass through the steel matrix [29]. This growth of the zinc corrosion products will additionally augment the barrier act of the galvanizing film. Additionally, the galvanizing film can serve as a sacrificial anode, where in zinc will corrode in comparison with the steel [30, 31].

Alloyed Steel (Stainless): This has corrosion-resistant property which is far better as compared to carbon steel and is expensive in nature. The fiberglass along with different corrosion-resistant composite materials is also used as substitutions for steel and for different other metals, nevertheless they are not appropriate materials for all purposes. The Duplex stainless steels (DSS) are corrosion resistant alloys widely employed in petrochemical as well as chemical industries. DSS comprise roughly equivalent volume proportions of ferrite (α) and austenite (γ), and large quantities of main passivating elements such as Cr, Ni and Mo [32-34]. In spite of extensive significance in correlating the formation as well as destruction of passive oxide layer with the electronic arrangement, the effect of Cu on the electronic properties of stainless steels is presently inadequate [35].

Cathodic Protection (CP): This refers to the use of an impressed direct current or a sacrificed anode, to lessen or eliminate the corrosion of metals (a cathode) [36]. The CP of metal could therefore be accomplished by pairing this photo nano-anode along with metallic electrode material. As discussed in the previously conducted researches, three major kinds of semiconducting oxides (nano-TiO_2, nano-ZnO, and nano-Fe_2O_3) are largely employed in the form of photo-electrode materials [37-43].

Eon Coat: The formulation of the EonCoat is hundred percent solids, water-based, non-hazardous, odourless and possess nil volatile organic compounds (VOCs) and hazardous air pollutants (HAPs). Coating application at a thickness of around 20 mils dehydrated to the touch in about one hour can be returned to service in about one hour and is totally cured within about 24 hours based on the temperature as well as humidity. The much swift arrival to service than is monitored for traditional epoxy and polyurethane coatings is an added benefit of the EonCoat process; fact is that CBPC coatings do not contain HAPs, VOCs and odour problems.

Economic implications of Corrosion

Corrosion affects the economy of an industry and country at large because the corrosion is found to occur in bridges, rails, automobiles, power plants etc; hence the costs associated with corrosion and preventive methods are of critical importance. Corrosion is also found to impact the GDP and import and export which are considered to be the

development or economic indicators for a given nation. Considering the range of applications affected by corrosion and its impact on economic status of a nation, focusing on the economics associated with corrosion is of prime importance. There is a common conviction that corrosion is a universal rival that must be taken into consideration as a practice that is unavoidable. Since products and production methods intricate as well as the additional price for corrosion failures have turned out to be costlier and better attentiveness has been created. Emphasizing on the above declaration as well as furthermore argues that corrosion is similar to corruption, when these are not uninhibited, they affect countries financial status in an irreparable way that revive most frequently tends to be an unrealizable illusion. Furthermore, an average of around 10 % of the overall yield of the metal around the globe is approximated to be as corrosion losses. This have an effect on a country's economic status and property namely utilities, logistics etc. The price of corrosion in industrially developed countries is around 3-4% of their Gross Domestic Product. During 3rd world war nation's spent 10 times more than estimated range to battle corrosion. In order to give credit to this statement, a study was done in 2003 in the most scientifically developed nation, United States, to determine the price of corrosion; the outcome demonstrated that the United States spent around thirteen times the overall Nigerian productivity and this was around $41.9 billion. The corrosion expenses were to a certain extent associated with an effort to offer an elegant look to engineering apparatus, designs as well as structures [44]. Partially due to the direct substitution and maintenance costs and simultaneous losses because of disturbance to operation of plant and extra expenses related to the application of costlier materials and additional protective steps. The practical investigation, transfer of knowledge, technological progress and technical advancements are needed in this direction [45]. The financial costs of corrosion are classified as Direct Cost and Indirect Cost. The Direct Costs are one which can be accounted quantitatively namely R and D cost, corrosion inhibition cost, substitution cost. In case of Indirect Cost, this cost cannot be assessed quantitatively; some of the instances are loss due to leakages in products and fire hazards, loss of income because of non-function of equipment, loss due to environmental pollution etc, estimation of prevention costs of corrosion is approximately in the range of 10% to 40%. Even though, most researchers have concentrated on the direct costs of corrosion, it is established that the effect of indirect cost of corrosion are considerably higher as compared to direct cost of corrosion [46, 47, and 48].

Economic analysis is deemed to me important as it has its own implications on imports and exports, Gross Domestic Product (GDP) etc. It seems important; to make some assessment of the economics of the matter which bears long term implications on the industries and nation at large. The corrosion effects may be classified external effects and internal effects. It would seem that corrosion waste must significantly add to the import content of these manufactured exports and thus reduce the 'profitability' of this transformation process to Britain [49]. As to the internal economic aspects of corrosion, it seems first of all that, in as much as corrosion varies with atmospheric pollution and distance from the sea, this might be one of the factors taken into consideration when either the Government or a firm determines the location of plant[49]. Corrosion costs are to a certain extent associated to effort to provide an pretty appearance to engineering machinery, structures as well as designs, partially due to the direct substitution and maintenance costs and coexisting losses because of interruption to plant operation and supplementary costs related with the employment of costly materials and precautionary actions [50]. Overall US cost of metal corrosion was approximated to be $70 billion, which was equal to 4.2% of GNP in 1975 and 15% was estimated to be preventable by employing corrosion control techniques at hand [51]. The overall corrosion costs in US is estimated by (i) adding up the costs of corrosion control techniques (ii) calculating the overall cost by extrapolating the corrosion costs of manufacturing sectors to the whole United States economy [51]. Figure 2 depicts the corrosion cost in different segments of US economy [52]. Corrosion costs have been appraised in segments namely, power plants wherein the costs of corrosion in 1988 were approximated to be $5.37 billion, 22% of these costs were preventable. The recent research carried out in the United Kingdom provided an annual cost evaluation in 5 aggressive environments namely Chemicals and Petrochemical segments; offshore sector; Automotive OEM sector; Food and Drink sector and Constructional Steel Work sector [54]. The total annual direct costs of corrosion were (1) The additional costly materials required to avoid corrosion damage (2) The labour involved in corrosion management, (3) Machinery needed for corrosion-associated events (4) Loss of capital because of corrosion-induced damage. The sum of all sectors was estimated as $137.9 billion per annum. The indirect costs of corrosion comprise

plant downtime, environmental pollution, over design and insurance costs. After these are added up to the direct costs, the total amount increases to $276 billion and contributes more than 3% to the United States. The Gross Domestic Product (GDP) greater than that of the mining and agriculture segments combined.

CONCLUSIONS

Corrosion is one of the major issue which results in the malfunction of the equipment and breakdown of the plant in severe circumstances. The corrosion process bears impacts on different aspects of the community ranging from energy, energy security to environment at large. The environmental problems posed by corrosion results in sustainability issues. It is evident that the nature of problems posed by corrosion is diverse and impacts are of high intensity. Therefore prevention of corrosion is vital and should be the order of the day. There are different preventive mechanisms; one should make a judicious decision regarding the selection of appropriate prevention method based on the nature and severity of the corrosion problem at hand. The economic impacts of corrosion cannot be disregarded as it impacts the imports and exports as well as GDP of a nation which are major indicators of development. Corrosion is found to affect land, air and water and has its own consequences as well. The further research should focus on studying the economic and environmental impacts extensively as these play a vital role in both growth and sustainability of a nation at large.

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Figure 1: Effects of corrosion on different areas of the community (courtesy: Gerhardus et.al. 4)

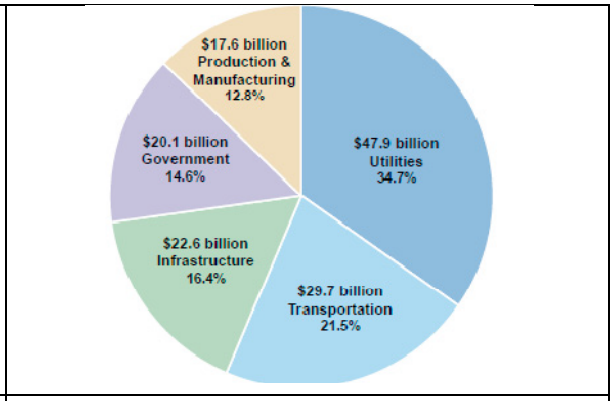

Figure 2: Cost intensiveness of corrosion on US economy [53]

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RESEARCH ARTICLE

Job Satisfaction in Shift Workers: A Questionnaire Survey

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ABSTRACT

We studied distribution of job satisfaction in a cohort of 481 shift workers (SWs), from different organizations with diverse shift-work patterns. The population of SWs consisted of 86 on running rotation (RR), 175 on weekly rotation (WR), 173 on quick rotation (QR), and 47 on split rotation (SR). We administered the job satisfaction Inventory to all SWs to determine their job satisfaction traits. Chi-square test indicated a statistically significant ($p< 0.05$) relationship between shift pattern and degree of job satisfaction. Multiple regression model was fitted to find out relationship between the dependent variable, Job Satisfaction score and number of independent variables, i.e., age, weight, height, Body surface area (BSA), Body mass index (BMI) and Morningness-eveningness questionnaire (MEQ). The results of ANOVA revealed that the regression was not statistically significant. When this relationship was viewed as function of shift pattern the regression of Job Satisfaction score was independent to the different shift patterns. In SR group the coefficient of the factor, specifically, MEQ was statistically significant. But in RR group, the coefficient of age was statistically significant. It suggests that young shift workers were less satisfied with their job than that of their counterpart.

Keywords: Job satisfaction, Running rotation, Shift workers, Quick rotation, Split rotation, Weekly rotation.

INTRODUCTION

Shift workers are among the most significant determinants and leading parts that determine the success of an organization in the competitive world. A reasonably good quality of human life demands round the clock services from different organizations dealing with health, security, transport, and entertainment (Fiorita *et al*., 2007). These organizations recruit manpower that works round the clock in shifts. It is well known that shift work modulates human health and social life negatively by way of disrupting circadian clock (Rosenthal and Howe, 1984; Staines and

Pleck, 1984). It does not allow shift workers to allocate adequate time for social interaction and participation (Bodla and Danish, 2009; Carpenter and Cazamian, 1977; Khaleque, 1998; Pohman and Gardiner, 2000; Rehman *et al*., 2013). This could be attributed to the consequences of pattern, duration, and direction of rotation of shift schedules. Several reports demonstrate that the 12-h shift system is better than the 8-h shift system (Jaffe *et al*., 1996; Smith *et al*., 1998; Williamson *et al*., 1994). The 12-h shift system produces lesser amount of stress, and enhances off-duty sleep quality and social happiness. It has been found to be less detrimental for social participation as compared with that of the 8-h rotating schedule (Iskra-Golec *et al*., 1996; Kaliterna and Prizmic, 1998). There are several studies that document job satisfaction among shift workers (Bolda and Danish, 2009; Cherian *et al*., 2018; Edwards *et al*., 2002; Myers, 2000; Rehman *et al*., 2013; Smith, 2001). Shift workers are satisfied with their jobs execute their responsibilities well and are committed to their job. Therefore it is important to know the level of job satisfaction with reference to the professional development programs, slow promotions, discrepancies from job description, job settings, rising workload etc (Awang *et al*., 2010; Cherian *et al*., 2018; Locke, 1969; Spector, 1997; Suma and Lesha, 2013).

Relationship between job satisfaction and shift work is far from conclusive. Several theories have been developed to define and measure job satisfaction (Alderfer, 1972; Awang et al 2010; Cherian *et al*., 2018; Dissanayake *et al*., 2016; Guirdham, 1995; Hackman and Oldham, 1975; Hertzberg, 1959; Kabir, 2018; Maslow, 1954; Suma and Lesha 2013). None of those is unequivocally accepted, although attempts were made to develop a satisfactory theory since the beginning of nineteenth century (Hoppock, 1935). Hackman and Oldman (1975) suggested that the degree of job satisfaction depends upon number of factors, such as meaningfulness of work, responsibilities for work outcomes and knowledge of work activities etc. Further they documented five dimensions, namely skill variety, task identity, task significance, autonomy and task feed- back that play important role in the fixation of job satisfaction. Prior to these studies authors mentioned nine most common job satisfaction domains such as salaries and benefits, recognition and promotion, management and supervision, co-workers, task requirement, organization policies, working conditions, nature of the job and job security (Mosadeghrad et al., 2008; Spector, 1997).

However, social support from workgroup and employer has been known to modulate job satisfaction considerably (Parkes, 1994). Further job satisfaction is also related to the age. Smith and Mason (2001) have reported that younger shift workers tend to show better tolerance towards the night shift and higher job satisfaction than that of their older counterparts. Relationship between life style and different types of shift systems are equally debatable. Both rotating and permanent night shifts elevate difficulties in family life that tends to restrict leisure and social responsibilities (Escriba- Aquir, 1992). In addition, these schedules have been reported to disturb sleep quality and sleep stages resulting in poor individual health and decrement in general performance (Tilley *et al.,* 1982). In the present study job satisfaction in different types of shift workers, viz., running rotational (RR), weekly rotational (WR), quickly rotational (QR), and split rotational (SR) were examined.

MATERIALS AND METHOD

Subjects: Four hundred eighty-one randomly chosen shift workers aged between 18 to 61 years (Median age = 35 y) volunteered to participate in this study.

Procedure of the study: Administered the job satisfaction inventory (MPI) to each subject belonging to each work type without disturbs the normal routine of the subjects.

Pattern of Shift Rotation: Running Rotation: The South-Eastern Central Railways (SECR) follows the counterclockwise running rotating (RR) shift system with ≥ 8 hours of work period. The SWs had an outstation break of 8-10 hours and headquarters (HQ) break of 16-24 hours during their work period. They rotated from the second night shift (00:00–08:00 h) to the first night shift (16:00–00:00 h) and to the morning shift (08:00–16:00 h). The pattern of this rotation was flexible as it depends upon actual timings of arrival and departure of the trains. *Weekly Rotation:*

The pattern of rotation of WR was similar to that of RR. The subjects in the category of SWs moved from the second night (00:00-08:00) to the first night (16:00-00:00) and to the morning shift (08:00-16:00). However, each SW of SECR worked six shifts in a row of each type. *Quick Rotation:* The Jindal Steel Plant Limited (JSPL) adopts the QR shift pattern. They experienced advance from the nighttime C-shift (22:00-06:00) to B-shift (14:00-22:00) and to A-shift (06:00-14:00). Every third day the shift rotated and they had a rest day after six consecutive days of work. *Split Rotation :*The Mohan Jute Mills Limited (MJML) adopted a unique shift pattern that involved A-shift (06:00-10:00 and 14:0018:00), B-shift (10:00-14:00 and 18:00-22:00) and C-shift (22:00-06:00). The workers of A- and B-shifts experienced two spells of 4 hours each punctuated by a rest span of 4 hours, whereas the workers of C-shift continuously worked for 8 hours. The rotation pattern was forward type involving shifting from A to B, B to C, and from C to A.

Characteristics of JS: Job satisfaction was assessed by means of a five-question inventory developed by Hackman and Oldham (1975), which measures the satisfaction of job and happy life.

Computation of JS scores: According to Hackman and Oldham (1975) sum of the scores between 5-7 was considered as strongly disagree, 8-12 as disagree, 13-17 as disagree slightly, 18-22 as neutral, 23-27 agree slightly, 28-32 as agree and 33-35 as agree strongly.

Statistical analysis: Data were analyzed with the help of software, namely SPPC (Version 10.0), CoStat (CoHort Software; Version: 4.02, ©1990) and Analysis ToolPak (Microsoft Excel). The *G*-test, *t*-test, Chi-square test, techniques for descriptive statistics, multiple regression and ANOVA were employed appropriately to test null hypotheses.

RESULTS

Distribution of Job satisfaction: Table 1 depicts the prevalence of different intensities of job satisfaction. Out of 483 subjects, 1 (0.21%), 5 (1.04%), 37 (7.66%), 238 (49.28%), 182 (37.68%), 17 (3.52%) and 3 (0.62%) belonged to different categories of job satisfaction, such as disagree strongly (Score < 7.5), disagree (Score between 7.5 and 12.5), disagree slightly (Score between 12.5 and 17.5), neutral (Score between 17.5 and 22.5), agree slightly (Score between 22.5 and 27.5), agree (Score between 27.5 and 32.5), agree strongly (Score between 32.5 and 35), respectively (Table 1).

Distribution of job satisfaction as function of shift pattern: Chi-square test indicated a statistically significant ($p< 0.05$) relationship between shift pattern and degree of job satisfaction (Table 1). The distribution of job satisfaction among RR subject in respect to disagree strongly, disagree, disagree slightly, neutral, agree slightly, agree, and agree strongly was found to be 0.00%, 3.49%, 15.12%, 33.72%, 43.02%, 3.49% and 1.16%, respectively. In the group WR, the corresponding figures were 0.00% (disagree strongly), 0.00% (disagree), 3.93% (disagree slightly), 55.62% (neutral), 35.96% (agree slightly), 3.37% (agree) and 1.12% (agree strongly). In the QR group those figures were 0.58%, 1.16%, 6.94%, 47.98%, 38.73%, 4.62% and 0.00%. The frequency distribution of job satisfaction (disagree strongly: 0.00%, disagree: 0.00%, disagree slightly: 10.87%, neutral: 58.70%, agree slightly: 30.43%, agree: 0.00% and agree strongly: 0.00%), compared with other groups, was different, in the SR group in that they had higher percentage of neutral group. Similarly, RR group exhibited higher percentages of disagree slightly and agree slightly than those of WR, QR and SR (Table 1). It was not possible to perform Chi-square test involving the paired groups because frequencies were either zero or less than five in different categories of job satisfaction. However, it was possible to perform the test between RR and QR. Individual frequencies of different levels of job satisfaction belonging to different shift patterns were compared by the G-test. The frequency of neutral in RR group was statistically significantly lower than those of WR group. All other comparisons did not yield rejection of the null hypothesis.

Relationship between age/ weight/ height/ BSA/ BMI/ MEQ and JS score: Multiple regression model was fitted to find out relationship between the dependent variable, JS score and number of independent variables, i.e.,

age, weight, height, BSA, BMI and MEQ. The results of ANOVA revealed that the regression was not statistically significant (p= 0.432). Correspondingly, when this relationship was viewed as function of shift pattern the regression of JS score was independent to the different shift patterns. In SR group the coefficient of the factor, specifically, MEQ was statistically significant (Table 2). But in RR group, the coefficient of age was statistically significant (Table 3).

Distribution of responses as function of JS option and shift pattern: Frequency distribution of responses as function of JS item, irrespective of life style and shift pattern is given in Table 4. Irrespective of the shift patterns, the subjects were satisfaction with their job (item nos. A, C and D) and they did not want to quit the job (item no. B). Moreover, they did not affirm about 'quit the job question' (item no. E) (Table 4). The Chi- square test revealed statistically significant relationship between JS options and shift pattern.

DISCUSSION

Shift work and job satisfaction are noteworthy issues that ensure proper nourishment in production organization. This in turn has a great impact on customer satisfaction and makes them wish to refer the employer. (Cherian *et al*., 2018; Dissanayake *et al*., 2016; Land, 1999). Further, bulk of the research conducted in this area suffers from limitations in that most of the respondents in those studies were university students. Therefore, it would be difficult to extrapolate the findings that show an association between job satisfaction and shift work for a general human population, probably the least for a typical human population that works in shifts. In this study, attempts have been made to ascertain if different types of shift schedules modulate job satisfaction differently, thereby giving indications about job satisfaction among shift workers in general and as function of the pattern of shift schedules in particular. In the present study the investigated population had four different backgrounds as far as types of shift schedules are concerned. The population in question involved RR, WR, and SR. It has been reported that shift workers often suffer from psychological complications and social inadequacies (Åkersted, 1990; Bohle and Tilley, 1990; Cherian *et al*., 2018; Fiorita *et al*., 2007; Kaliterna and Prizmic-Larsen, 1998; Kaliterna *et al.,* 2004; Suma and Lesha 2013). Job satisfaction is in itself a complex concept and it is very difficult to interpret it objectively as it is influenced by so many factors, such as social, cultural, organizational, and environmental etc. (Devi and Velayudhan, 2003; Konstantinos and Christina 2008; Spector 1997). The factors that influence JS could be both internal as well as external. For example, the latter could include factors, such as reward of money and leisure at home etc. (Cherian *et al*., 2018; Solheim, 1988).

The results indicated greater percentage of subjects in QR and WR groups, who selected *neutral* and *slightly agree* options in connection with the JS. When the item wise frequency distribution of the responses (optionwise) analyzed, the subjects accepted job satisfaction criteria but partially denied the same with respect to their coworkers. The RR subjects thought of quitting their job very often. The SR subjects too expressed dissatisfaction and were desirous of switching over to other organizations. This could be attributed to poor coping abilities to shift work. The coefficient for age was statistically significant in the regression model. It suggests that young shift workers were more dissatisfied with their job. It was prominent in the RR group. Age-related job satisfaction among shift workers has been reported (Nakagawa *et al.,* 1993). However, there are so many other factors, such as promotions, remuneration (Helson, 1964), turnover (Mobley, 1977), productivity, absenteeism, commitment, mental/ physical health (Locke, 1976; Mottaz, 1985), and environment (Cummins, 2000) could modify Job Satisfaction dramatically. It is noteworthy to state that the QR group appeared to be the best than that of their counterparts. Despite the fact that job satisfaction remains as an indefinite construct since the beginning of the twentieth century, its dimensions have been studied regularly (Dissanayake *et al*., 2016; Hoppock, 1935; Locke, 1976; Mottaz, 1985; Smith *et al*., 1999). The rotating shift work has been reported to affect Job Satisfaction of employees differentially (Demerouti *et al*., 2004). Nonetheless, the evidence that shift work appears to impair the health, domestic life, and social activities of millions of workers and their families indicates that more effort needs to be devoted now by government, industry, organized labour, the local community, and shift workers themselves toward ameliorating these widespread, harmful consequences of evening and nighttimes employment.

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DISCLOSURE STATEMENT

The authors report no conflicts of interest.

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Table 1 Prevalence of job satisfaction as function of shift pattern

Shift Pattern	Disagree Strongly		Disagree		Disagree Slightly		Neutral		Agree Slightly		Agree		Agree Strongly		All	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	N
RR	0.00	0	3.49	3	15.12	13	33.72	29	43.02	37	3.49	3	1.16	1	17.81	86
WR	0.00	0	0.00	0	3.93	7	55.62	99	35.96	64	3.37	6	1.12	2	36.85	178
QR	0.58	1	1.16	2	6.94	12	47.98	83	38.73	67	4.62	8	0.00	0	35.82	173
SR	0.00	0	0.00	0	10.87	5	58.70	27	30.43	14	0	0	0.00	0	9.52	46
Total	0.21	1	1.04	5	7.66	37	49.28	238	37.68	182	3.52	17	0.62	3	100.00	483

Shift pattern *versus* job satisfaction: χ^2*-value* = 30.245*; df* = 18*; p*< **0.05**

[RR]Running rotational; [WR]Weekly rotational; [QR]Quickly rotational; [SR]Split rotational

Table 2 Multiple regression coefficients for JS score[†], by age, weight, height, BSA, BMI and MEQ in shift workers of MJM on split rotational shift duty (SR)

Regression Statistics				
	Coefficients	**SE**	**t Stat**	**P-value**
Intercept	140.238	67.523	2.077	0.044
Age (y)	0.074	0.058	1.285	0.206
Weight (kg)	1.160	0.773	1.502	0.141
Height (m)	-60.370	53.905	-1.120	0.269
BSA (m^2)	-21.644	48.954	-0.442	0.661
BMI (kg/m^2)	-2.730	1.389	-1.965	0.056
MEQ	0.201	0.069	2.933	**0.006**

(Based on responses of subjects on items 1-5 depicted in Job Satisfaction Inventory (Refer Appendix V); [MJM]Mohan Jute Mill

Table 3 Multiple regression coefficients for JS score[†], by age, weight, height, BSA, BMI and MEQ in shift workers (running staff) of SECR on rotational shift duty (RR)

Regression Statistics				
	Coefficients	**SE**	**t Stat**	**P-value**
Intercept	47.240	56.136	0.842	0.403
Age (y)	0.137	0.064	2.137	**0.036**
Weight (kg)	0.775	1.324	0.585	0.560
Height (m)	7.350	63.211	0.116	0.908
BSA (m^2)	-43.644	91.943	-0.475	0.636
BMI (kg/m^2)	-0.732	1.277	-0.573	0.568
MEQ	-0.034	0.101	-0.342	0.733

[†]Based on responses of subjects on items 1-5 depicted in Job Satisfaction Inventory [SECR]South Eastern Central Railway

Table 4 Frequency distribution of responses† as function of option (item wise) in JS

MEQ	Item				
Option	**a**	**b**	**c**	**d**	**e**
1	13	252	12	24	70
2	11	91	13	70	73
3	14	39	27	48	66
4	17	32	25	90	122
5	69	40	81	85	92
6	118	22	191	95	41
7	241	7	134	71	19

†Based on items 1-5 depicted in job satisfaction inventory

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REVIEW ARTICLE

UPLC™ - A Review on its Recent Advances in Instrumental Analysis

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ABSTRACT

UPLC is a modern technique that gives a new direction for liquid chromatography. The UPLC refers to the ultra-performance liquid chromatography, which enhances mostly in three areas: "speed, resolution, and sensitivity. Ultra-performance liquid chromatography (UPLC) applicable for particles less than 2μm in diameter to acquired better resolution, speed, and sensitivity compared with high-performance liquid chromatography (HPLC). In the twenty-first-century pharmaceutical industries are concentrate on new ways to in the economy and shorten the time for the development of drugs. The quality analysis of various pharmaceutical formulations is transferred from HPLC to the UPLC system. The separations on the UPLC are performed under very high pressure (up to 100MPa). The separation efficiency remains maintained or is even improve by UPLC. The review introduces the theory of UPLC.

Keywords: UPLC, Chromatography, HPLC

INTRODUCTION

UPLC refers to Ultra Performance Liquid Chromatography. It better in three areas: chromatographic determination, speed, and reactivity analysis. It uses fine pieces and saves time and reduces solvent utilization. UPLC comes from HPLC. HPLC has been the development of the packing materials used to effect the separation. A fundamental principle of the HPLC command that as support packing piece size decreases, regulation and thus determination also increases. As particle size decreases to less than 2.5m, there is a notable gain in regulation and it's doesn't reduce at increased linear velocities or flow rates according to the common Van Deemter equation [1,2].

By using little particles, speed and submit capacity (number of peaks resolved per unit time) can be enlarged to new limits which are known as Ultra Performance. The classic separation system is of HPLC (High-Performance Liquid Chromatography) with frequent advantages related to robustness, ease of use, superior selectivity, and irregular reactivity. Its main control is the lack of efficiency differentiate to gas chromatography or the capillary electrophoresis due to low diffusion coefficient in a liquid phase, require slow scattering of analyzing in the stationary phase. The Van Deemter equation shows that regulation increases with the use of smaller size particles but this leads to a fast increase in back force, while most of the HPLC structure can use only up to 400 bars. That is why short support filled with particles of about 2m are used with these systems, to further the analysis without loss of order, while continuing a tolerable loss of load [3].

To improve the organization of HPLC separations, the following can be done:-

a) Work at higher temperatures
b) Use of monolithic columns.

SMALL PARTICLE CHEMISTRY

As the particle size reduces to less than 2.5μm, not only there is a significant gain in efficiency, but the efficiency doesn't diminish at increased move rates. By using small particles, speed and peak capacity (number of peaks solve per unit time in rising dissociation) can be expanded to a new maximum, termed ultra-performance liquid chromatography [3]. Indicates that the decrease in particle size results in an increase in regulation of column and on the other hand growth in linear velocity (flow rate) increase the efficiency for the column for particle size less than 1.9 μm and after the optimized flow it remains the same, while for support with particle size greater than 1.9μm, efficiency again decreases after fixed optimized flow. A commercially accessible non-porous, high smaller particle has poor loading size and retention due to low surface locality. To continue retention and capacity must use novel porous particles that can withstand high force. In 2000, a hybrid of silica and the polymeric column was present which contain classical sol-gel synthesis that absorbs carbon in the form of methyl groups, these columns are mechanically strong. They are higher efficiency and can be work at a wide range of pH [4].

PRINCIPLE

The UPLC is found on the principle of use of stationary phase contain the particles less than 2.5 μm (while HPLC columns are regularly filled with particles of 3 to 5 μm). The basic principles of this evolution are control by the Van Deemter equation, which is an observed formula that traces the relation between linear velocity (flow rate) and plate height (HETP or column regulation).

$$H = A + B / w + Cv$$

where;

(i) A, B, and C are constants
(ii) v is the linear velocity, the conveyor gas flow rate.
(iii) The A term is independent of acceleration and constitutes eddy's mixing. it is smallest when the packed column particles are small and constant.
(iv) The B term represents axial diffusion or the natural diffusion propensity of molecules. This effect decreases at high flow rates and so this term is divided by v.
(v) The C term is due to kinetic opposition to equilibrium in the detachment process. The kinetic resistance is the time lag intricate in moving from the gas phase to the packing halted phase and back again. the significant the flow of gas, the more a molecule on the load tends to lag supporting molecules in the mobile phase. Thus the term is proportional to v. Therefore it is possible to enlarge throughput, and thus the speed of the survey without affecting the chromatographic performance. The appearance of UPLC has required the development of a new involved system for liquid chromatography, which can take ahead of the disconnection effecting (by reducing dead magnitude) and compatible with the pressures (about 8000 to 15,000 PS1, collate with 2500 to

5000 PSI in HPLC). Efficiency is corresponding to column length and conversely comparable to the particle size (Lars and Honore, 2003). As shown in Figure 1, smaller particles furnish increased efficiency as well as the capacity to work at increased linear velocity without a loss of efficiency. providing both intention and speed. Efficiency is the main severance parameter behind UPLC since it depends on the same decision and coherence as HPLC [6].

Comparison between UPLC and HPLC

Principles are the same but not the performance

The concept of UPLC is the same principle as HPLC, the basic contrast is the designer of the column substance particle size which less than 2-μm. Which makes big respect in performance and to enlarge the advantages of these columns, creating a strong, vigorous, and reliable compound. The near design of UPLC H-class's Quaternary Solvent Manager (QSM) and Sample Manager (SM- FTN), with flow-through arrow design, gives all the give and usability of your current HPLC while still reach the highly structured separations that only UPLC can provide [7,8].

To improve the UPLC Efficiency

1. By utilizing high temperature which decreases the viscosity of mobile phase and at length flow rate if high. Importantly backpressure is decreasing.
2. The unique quality of the UPLC analyzer is interconnected shell and interconnected flow paths (through – pores) which are being in monolithic columns make the UPLC technique individual from HPLC [9-11].

INSTRUMENTATION

1. Sample Injection
2. UPLC Columns
3. Detectors
4. Pumps

SAMPLE INJECTION

In UPLC, the beginning of the sample is analytical. Standard injection valves, either electric or manual, are not sketch and hardened to work at utmost pressure. To protect the column from extreme pressure alterations, the injection process must be approximately pulse-free and the swept volume of the device also requires to be minimum to reduce potential band open out. A quick injection circle time is needed to fully take advantage of the fast provide by UPLC, which in turn needs an elevated sample volume. Low magnitude injections with minimum carryover are also needed to increase reactivity. There is also direct injection application for biological samples

UPLC COLUMNS

Resolution is increased in a 1.7μm piece-packed column because planning is better. Separation of the ingredient of a sample need a bonded phase that dispenses both preservation and selectivity. Four bonded phases are available for UPLC separations:

i. ACQUITY UPLC TM BEH C8 (straight-chain alkyl columns),
ii. ACQUITY UPLC TM BEH C18 (straight-chain alkyl columns),
iii. ACQUITY UPLC BEH Shield RP18 (implant polar group column) and
iv. ACQUITY UPLC BEH Phenyl (phenyl group tethered to the silyl performance with a C6 alkyl),

Each column chemistry supplies a different mix of hydrophobicity, silanol activity, hydrolytic stability, and chemical interchange with analytes. ACQUTTY UPLC BEH C18 and C8 columns examine the universal columns of choice for most UPLC separations by providing an extensive pH range. They include tri-functional ligand bonding chemistries which produce superior low pH stability. This low pH stability is merged with the high pH stability of the 1.7μm BEH particle to carry out the broad usable pH utilize range. ACQUITYUPLC BEH Shield RP18 columns are designed to provide selectivity that companion the ACQUITYOPLC BEH CI8 and C8 phases. ACQUITY UPLC BEH Phenyl

line makes use of a tri-functional C6 alkyl in conjunction connecting the phenyl round and the silly production. This ligand, integrate with the same corrective end-capping procedure as the ACQUITY UPLC BEH C18 and C8 columns, provides long column lifetimes and magnificent peak shape. This unique mix of ligand and end-capping on the 1.7μm BEH particle creates a new measurement in selectivity allowing a rapid match to the existing HPLC column. An inner dimension (ID) of a 2.1 mm line is used. For maximum decision, choose a 100 mm length and for faster analysis, and excessive sample throughput, choose a 50 mm column. Half-height peak widths of less than one second are obtained with 1.7μm particles, which gives remarkable challenges for the detector. In order to amalgamate an analyte peak precisely and consistently, the detector sampling rate must be high sufficient to capture enough data points across the peak. The detector cell must have minimal dispersal (volume) to conserve detachment planning. Theoretically, the susceptibility increase for UPLC detection should be 2-3 times higher than HPLC separations, depending on the detection technique. MS detection is significantly increased by UPLC; increased peak mass with lessen chromatographic scattering at lower flow rates advance increased source ionization regulation. The ACQUTTY UPLC System contains a binary stable manager, sample executive inclusive of the column heater, detector, and voluntary sample developer.

The binary solvent controller uses two single serial flow pumps to deliver a parallel binary incline. There are built-in solvent choose valves to choose from up to your solvents. There is a 15,000-psi oppression limit (about 1000 bar) to take full advantage of the sub-2μm particles. The sample manager also assimilates several technology evolutions. Using oppression-assisted sample introduction, low dispersion is continued through the injection process, and a series of oppression transducers case self-monitoring and diagnostics. It uses needle-in-needle sampling for enhancing toughness and the needle positioning sensor increases precision. Injection cycle time is 25 seconds after a wash and 60 sec with a dual wash used to develop decrease transfer over. A variation of microtiter plate styles (deep well, mid-height, or vials) can also be accommodated in a thermostatically controlled environment. Using the voluntary sample organizer, the sample manager can inject from up to 22 microtiter plates. The sample controller also controls the column header. Column temperatures up to 65°C can be accomplished. To reduce sample dispersion, a pivot-out design authorizes the column outlet to be placed in closer nearness to the source inlet of an MS [12].

DETECTORS

The detectors are used in UPLC analyses is UV / Visible detector. Detection of analytes is accepted based on absorbance that is concentration sensitivity detectors. In UPLC the flow cell volume would have to be reduced to continued concentration and signal. Based on Beer's Law, small volume accepted move cells would also reduce the pathway length upon which the signal power depends. A reduction in cross-section means the light path is reduced, and transmissions drop with increasing noise. Therefore, if a standard HPLC flow cell were used, UPLC sensitivity would be comprised. The ACQUITY Tunable UV/Visible detector cell consists of a light-guided flow cell identical to an optical fiber. Light is efficiently transmitted down the flow cell in an internal reflectances mode that still continues a 10mm for cell path length with a volume of the only 500mL. Tubing and connection system are efficiently routed to continue low dispersion and to take advantage of leak detectors that interact with the software to alert the user to potential problems [13].

PUMPS

The UPLC pumps is considered to be one of the most important components in a liquid Chromatography system which has to provide a continuous constant flow of the eluent through the UPLC injector column and detector

The two basic classifications are

- Constant pressure pump
- Constant flow pump

STANDARD UPLC PUMP REQUIREMENTS

The sample injection volume is as reduced as 3 - 5 microliters

↓

Pumps operate at 1000 psi pressure

↓

Particle size in stationary phase packaging material is less than 2-micrometer detector.

TYPES OF PUMPS

Reciprocating piston pumps

The basic principle of the reciprocating single piston pumps is that they throw out liquid through a one-way valve (check valve). The pumping rates are usually regulated by direct the distance the piston retracts, thus limit the amount of liquid press out by each stroke, or by the cam rotation speed (Figure:6) [14,15].

Dual Piston Pumps

A more efficient way to provides a constant and almost pulse-free stream is the use of dual-headed reciprocating pumps. The two pump chambers are driven by the equal motor through a common eccentric cam; this prevalent drive allows one piston to pump while the other is refillings (Figure: 7).

Dual-head Reciprocating pumps

The advantage of these pumps is the immense solvent source allows long-term unattended use and quick change over and clean out capacity. However, unless special care has been exercised in produce, these pumps may have several disadvantages. There is a tendency for the incompleted compensated pulsations to be visible at higher refractive index detector sensitivities, mainly at lower flow rates where piston cycles are widespread (Figure:8) [16].

TYPES OF UPLC BY WATERS

ACQUTY UPLC 1-Class provides the determiner powerful solution to the most analytic need in dissociation science today-successfully analyzer compounds that are little in amount or availability between a complex matrix, more quickly than ever before. Advance to produce the most exact and reproducible separations, become the most information possible and further laboratory results Complex separation opposition require LC systems designed to enlarge the interest of sub- 2-μm particle columns combined in a system draw to optimize MS performance.

The ACQUITY UPLC I-Class system

- Maximizes peak capacity to enhance MS sensitivity.
- Provides the small carryover, accompany MS sensitivity, and extending MS linear dynamic range.
- Experience has been purposefully engineered for the lowest dispersion, with an extended pressure/ flow envelope, complex separations can be further without composing chromatographic accuracy.

The ACQUITY UPLC H-Class is an efficient system that brings at the same time the flexibility and Simplicity of quaternate solvent combine and a flow-through-needle injector to provide the advanced presentation expected of UPLC type separations-high resolution, sensitivity, and enhance throughput -while continuing the robustness and constancy that ACQUITY systems are known for.

Choosing the ACQUITY UPLC H-Class enables to continue management of the existing HPLC system on a forward-looking LC platform that permits to confidently and seamlessly change to UPLC separations, using combined system Tools and dependable column kits for method carry and method evolution that clarify migration.

The nano ACQUITY Ultra Performance LC (UPLC System is outlined for nano-scale, capillary, and narrow-bore dissociation to attain the highest chromatographic intention, sensitivity, and assurance. Personal nano-flow presents significant improvements over traditional nano-flow separations mechanisms. It better peak capacity and peak shape, and increase the number of ingredients that can be recognized per separation. The system's 10,000 psi work pressure potential allows for senior high-pack capacity separations by work longer columns fill up with sub-2 micron particles. It is improved for high-resolution togetherness and 2D-LC separations at a precise nano-flow amount. The nano ACQUTTY UPLC System supply solutions for biomarker discovery and proteomics requests, for identification and characterization.

The PATROL™ UPLC Procedure Analyzer is a real-time Process Analytical Technology (PAT) system that determines and quantifies complex different component manufacturing test and the final product in person on the production floor. Designed preposition the identical authorized technology that guides the ACQUITY UPLC System, PATROL UPLC progress be liquid chromatography (LC) analyzer from of-line Quality Control (QC) laboratories personally to the cause process, develop in a significant advance in construction regulation:

Delivers Real-Time LCT™ analysis in step with manufacturing processes.

- Issue the selectivity, sensitivity, and dynamic range of LC inspection.
- UPLC's fast determine power quickly quantifies connected and unrelated combinations.
- Bring to process cycle times, so that more effect can be produced with existing assets.
- Enables manufacturers to produce more material that consistently meets or exceeds the t specifications, potentially eliminating variability, failed batches, or the need to re-work material.
- Assures end-product quality, including final release testing.

The PATROL UPLC Process Analysis is an ideal mixture for pharmaceutical, biopharmaceutical, petrochemical, and food producer that are under increased inner and outer force to decide PAT programs and techniques. Global regulatory initiatives, such as the U.S. Food and Drug government and European Medicines Agency analytic Path and PAT capability, and produce quality-by-design initiative, such as Six Sigma, are driving council to assess and instrument novel PAT solutions like as the PATROL UPLC System.

The PATROL UPLC® Laboratory Analyzer provides a real-time quantitative analyzer of chemical reactions in process growth and expansion workshop. Proven UPLC® Technology and Real-TIME LC™ analysis have been combined with an online analyst that provides fast and perceptible quantitative results to specify process methods. Spectroscopic technologies used in process development laboratories provide identity information about the processes; however, lack the ability to simultaneously monitor multiple components at different levels and do not allow the significant analysis, sensitivity, linearity/active range, and the decision that UPLC provides[17].

ADVANTAGES

1. Decreases run time and increase sensitivity.
2. Give the selectivity, sensitivity, and dynamic range of the LC analyzer
3. Maintaining resolution performance.
4. Expands scope of Multi residue Methods.
5. UPLC's fast resolving power rapidly quantifies related and unrelated compounds.
6. Faster analyzer through the use of a novel separation substance of very fine particle size.
7. Functioning cost is reduced.
8. Less solvent consumption.

9. Reduces process cycle times, so that additional products can be produced with existing resources.
10. Increases sample throughput and prepares manufacturers to produce more material that constantly meets or exceeds the product specifications, potentially eliminating variability, failed batches, or the requirement to re-work material.
11. Delivers real-time analyzer in step with manufacturing processes.
12. Assures end-product quality, including final announce testing [18,19].

DISADVANTAGES

1. A considerable disadvantage of UPLC is the higher back pressures in contrast to conventional HPLC which decreases the being of the support. Increasing the line temperature decrease the back force problem in UPLC.
2. In addition, the phases of less than 2 μm are in general non-regenerable and thus have restricted use [20].

TROUBLESHOOTING IN UPLC

Liquid chromatography is a powerful systematic method of analysis, however, when a UPLC or HPLC system begins to fail, it can mean a significant amount of time and measures to fix. Some system trouble, such as a leak in the pump, can be observed by an expert chromatographer, while another issue, such as inaccurately connected column outlet tubing, can be a subtle worry and difficult to troubleshoot. By using a chartered system fitness standard, a chromatographer can more easily determine problems within their system, clearly reducing system intermission. Waters Neutrals Quality Control Reference Material (QCRM) is an associate of three neutral combinations: acetone, naphthalene, and acenaphthene. These combinations produce batch-to-batch reproducibility in a direct setting ensuring steady results over time. This excellence is an ideal solution for system troubleshooting and maintenance as the separation of these compounds can be attained under the common mobile phase decide with enough organic satisfaction. In this request, six common chromatographic problems are inspected to demonstrate the value of the Neutrals QCRM in rapidly detection problems on a UPLC or HPLC system. After restore was made, the Neutrals QCRM was used to rapidly confirm that the system was back to utilize optimally. By using the Neutrals QCRM to arrest system purpose, data classification can be certain and the system can be used with dependence. By using Neutrals QCRM method to diagnose similar chromatographic issue, shown in Table1.

Forty-five injections of the Neutrals QCRM were run on a lately measured ACQUITY UPLC H-Class with ACQUITY UPLC PDA detector for five days, as shown in Table 2, prior to any system defect or user error. As a role of a system benchmarking process, the mechanic should create suitable specifications according to laboratory agreement that the Neutrals QCRM must pass in order for the arrangement to be observe working optimally.2 By creating these specifications, the method performance can be tracked, potentially infectious problems ahead they arise To arise the troubleshooting volume of the Neutrals QCRM, the first affair signify is the result of a weakness column on the dissociation. Over time, with replicate injections, all LC columns will lose their order and potential to separate part of a mixture. In Figure 9, the separation of the Neutrals QCRM on an ACQUITY UPLC BEH C18, 2.1 x 50 mm, 1.7 µm Column that had been unreasonably used is shown and contrasts with the separation acquire on a column with allowable performance. As Figure 9 shows, the failing column is brought about peak splitting of both the naphthalene and acenaphthene peaks. Monitoring the USP plate dish for the acenaphthene peak, the value release to approximately 1000 with the weakness column, shown inTable 3. After the failing column returned with a new column, nine injections of the Neutrals QCRM were a journey. The features from these nine injections, shown in Table 3, are equivalent to the benchmarked data, designate that the system is operating perfectly prior to column failure. The low %RSD of the combined retention times behind column replacement, as well as the even return to similar plate counts and tailing factors, indicate that the system is back to the normal presentation. The second system issue demonstrated is the broken pump bring about by a leak. Once the leak was produced, the Neutrals QCRM was analyzed, shown in Figure 10. When a small leak was attending in the pump, all of the summits were still eluting within the sample run journey; however, there is a transport in retention times and a small change in the system compulsion. With severe specifications set in the laboratory, the approximate 10% contrast in retention times, shown in Table 4, may fall the case of the specifications, caution the analysis of a potential system issue. Integrate

with the pressure difference, this may be desired to the analyzer that the pump could be failing. After the pump was restored, the system was re-checked for production using the Neutrals QCRM. Nine injections of the level were performed and the data was assembled, shown in Table 4. The incorporated retention time %RSDs were short than 0.7 for all peaks behind the leak was repaired, which support that the system was back to normal performance. A third usual system difficulty is a bad check valve. Check valves assist to balance flow and pressure in an HPLC/UPLC apparatus. Above time, these valves maypole and flatter clogged depending on the types of mobile phase handed-down. When they begin to fail, there can be observable chromatographic and pressure distribution in a system. The dissociation of the Neutrals QCRM on a system preposition a bad check valve contrast to a good check valve is shown in Figure 11. The retention times of all three summit shifts with the bad check valve differentiate from the good check valve. This small change in retention time brings about by the check valve not living able to set the flow of the mobile phase successfully. In this case, not only did the retention of the composite increase but the plate count release by 26% for naphthalene, shown in Table 5. This move-in retention time, as well as the reduction in plate count, may origin a run of the standard to drop out of identification. After the inspect valve was restored, the system live checked for performance once more by running an added nine injections of Neutrals QCRM, shown in Table 5. In this case, the plate include and retention times of the nine injections were similar to the benchmarked data, desired a normally functioning system after restore of the check valve.

A fourth common mode of abortion in an LC system is unsuitable column relation. Incorrectly connecting the tube to the column can happen when exchange columns and can result in a gap connecting tubing and column end part. This gap can work on peak shape, certainly widening peaks, resulting in excessive peak pursuit or shouldering. The dissociation of the Neutrals QCRM on a column with an inappropriate connection compared to a column that is properly attached can be seen in Figure 12.

In this example, the dissociation of the Neutrals QCRM with the unsuitable column interrelation shows only slight exchange in the separation differentiates to the proper column relation. The result of unsuitable column connections can vary depending on the extent of the gap generate. In this case, the pursuit of the naphthalene peak increases moderately with the poor tubing equipment as well as the observation of the acenaphthene heights. These changes could desirable many issues with the system. Each peak is pretentious unusually and as the differences are only small, they might go overlooked. In addition to the tall tailing of the naphthalene peak, a detection in plate count is further observed, shown in Table 6. Depending on evaluation and specifications, this drop-in plate count may source system performance inspect to stop. By associate the column properly and feed nine injections of the excellence, the system presentation was re-checked, shown in Table 6. The tailing element for naphthalene returned to about 1.1, and the plate includes increased and returned to the same presentation as the benchmarked data, desirable that the system has returned to excellent operation. A fifth ordinary problem in LC is an air illusion in the solvent line, which can give rise to deficient system priming or managing out of solvent in the solvent container. Once an air bubble forms, it can influence the system pressure and mobile phase transportation. The result of an air bubble on the dissociation of the Neutrals QCRM is shown in Figure 13.

With air in the apparatus, the retention time of all the summit has transferred. The air in the solvent underline or pump can source improper transportation of the mobile phase, thereby shifting retention time. In this case, a 25% increase in retention of the naphthalene peak was a move, shown in Table 7. By re-priming the apparatus with the mobile phase, the air was separate from the system. Considered the data from nine injections of the Neutrals QCRM after removing eliminate air from the system, shown in Table 7, the retention times have to give back to where they were through system benchmarking, advisable the system no longer has an air bubble. The final regular problem seen in LC that was considered in this application is a different organic composition in the mobile phase, which can take place during the mobile phase mixture due to analyzer error. The inappreciable difference in mobile phase composition can have a result in chromatographic results, preposition increasing or decreasing retention times, and certainly bring about co-elution of the spire. In this application, the interest of acetonitrile was change by ± 2% for the analyzer of the Neutrals QCRM. Figure 14 shows the dissociation with utilize mobile phase creation of 48%, 52%,

and 50% (recommended composition) acetonitrile. Predictably, the different organic composition has a significant result on the isocratic dissociation of the standard. A retention flow shift of 25% for the naphthalene summit was detected when the mobile appearance contained 48% acetonitrile, while a 21% decrease in retention time takes place when 52% acetonitrile was near in the mobile phase, shown in Table 8. Once the initial mobile phase structure (50% acetonitrile) was deposit back to the system, nine injections of the Neutrals QCRM passed to re-check the system presentation, shown in Table 8, and to indicate proper system action. The retention times of all the peaks were equivalent to the benchmarked data, designate that the mobile phase was made perfectly and that the system is work as it should. The Neutrals QCRM is consistent with many mobile periods, and if the mobile phases for selected analyzer are used to both benchmark and troubleshoot the system, the interest of the Neutrals QCRM for troubleshooting mobile phase mistake can be understood. While this application distinct from the use of 50% acetonitrile, more mobile phases with enough organic constitution may be used. Without the use of a degree to check system conducting, an error in mobile phase compound could source irreproducible chromatography or co-elution of kill peaks in real samples, develop in extensive and unnecessary method evolution, or reanalysis of the choose Actual, with proper specifications for the Neutrals QCRM, errors in natural configuration may be recognized time is charge in sample analyzer [21,22].

APPLICATIONS OF UPLC

Analysis of natural products and traditional herbal medicine

UPLC supplies high-quality detachment and detection capacity to identify active composite in highly complex samples that result from natural products and traditional herbal medicines. Metabonomics-based analyses, using UPLC, exact mass MS, and Marker Lynx Software data process for multivariate statistical analyses, can help quickly and exactly characterized these medicines and also their effect on human metabolism.

Identification of Metabolite

Biotransformation of new chemical entities (NCE) is required for drug discovery. When a compound reaches the development stage, metabolite identifications become a regulated process. It is of the maximum importance for the lab to successfully detects and identify all circulating metabolites of a candidate drug. UPLC/MS/MS addresses the compound analytical essential of biomarker discovery by offered unmatched reactivity, resolution, dynamic range, and mass accuracy.

Study of Metabonomics Metabolomics

Metabonomics studies bring out in labs to advance the development of new medicines. The facility to compare and contrast large sample groups to provide insight into the biochemical changes that occur when a biological system is exposed to a new chemical entity (NCE). Metabonomics provides a rapid and robust method for detecting these change, improves understanding of potential toxicity, and allow monitoring the efficacy. The accurate implementation of metabonomic and metabolomic information helps similar discovery, development, and manufacturing processes in the biotechnology and chemical industry companies. The UPLC analysis quickly generates and interprets information-rich data, allowing rapid and informed decisions to be made.

ADME (Absorption, Distribution, Metabolism, Excretion) Screening

ADME studies measure physical and biochemical properties - absorption, distribution, metabolism, elimination, and toxicity of drugs where such compounds exhibit activity agonists to the target diseases. Tandem quadrupole MS combines with UPLC in ADME screening for sensitivity and selectively with a fast analysis of the sample in a matrix to be achieved with minimal cleanup, by MRM (multiple reaction monitoring) for detection and automatic compound optimization

Bioanalysis /Bioequivalence Studies

Application of UPLC/MS/MS in bioequivalence and bioanalysis is: In UPLC/MS/MS, LC and MS instrument and software merge in a sophisticated and integrated system for bio analyses and bioequivalence studies, provide

unprecedented performance and conformity support. UPLC/MS/MS supply excellent chromatographic resolution and sensitivity. Increase the sensitivity of analysis, quality, or data include lower limits of quantitation (LLOQ), and production of a laboratory by coupling the UPLC System's structured separations with a fast acquisition rate of organization quadrupole MS Systems. Easily receive, quantify and describe full system data in a compliant environment employ Security-based data collection software. Ensure the highest standard results and dependable system performance in a balanced environment.

Dissolution Testing

For quality control and released in drug manufacturing, dissolution testing is essential in the Formulation, development, and production process. UPLC provides exact and reliable automated online sample acquisitions, automatic dissolution testing, from capsule drop to test start, through data investment and analyzer of sample aliquots, to the management of test result publication and scattering.

Forced Degradation Studies

The FDA and ICH require stability testing data to realize how the quality of an API (active pharmaceutical ingredient) or a drug result changes with time receiving the influence of environmental elements such as heat, light. pressure and water or humidity. UPLC integrate with specific Photodiode array pointer and MS detection will give dependence for identifying degradation products and thus condense the time required to begin stability-indicating methods.

Manufacturing /QA / QC

Identify, purity, quality, safety, and efficiency are the main factors to be experimental while constructing a drug product. The successful presentation of quality pharmaceutical products needs purity of raw materials and complete products. UPLC is used for the high control, the quantitative analysis performed in QA/QC laboratories

Method Development / Validation

According to FDA, validations is defined as establishing documented verification that provides a high degree of confidence that a specific process will consistently manufacture a product meeting pre-established specifications and quality attribute. Method development and validations is a time-consuming and complicated process: labs require to evaluate multiple mixtures of Mobile phase, pH, Temperature, column chemistries, and rise profiles to arrive at a robust, definitive separation for every occupation.

The following parts of UPLC arc important to give the required information:

1. UPLC columns: High solidity allows for a wide range of support temperatures and pHs to be inspected.
2. UPLC Column Manager: Easily evaluated column temperatures from 10 °C below room temperature to 90 °C; enable to use of HPLC methods on the UPLC previous to scaling to UPLC. UPLC Calculator: Particulars at fingertips around how to change the existing chromatographic analyzer to a faster UPLC system.

Impurity Profiling

Impurity profiling requires high-resolution chromatography capable of certainly and reproducibly separating and detected all of the known impurities of the active compound. UPLC systems and Columns especially address high-throughput analyzer requirements while maintaining high decision. UPLC PDA detector involves two analytical flow cells that are accessible for the highest flexibility according to application requirements, one for highest chromatographic resolution and a second for high reactivity. UPLC also involves the newest peak detection algorithms and customs calculations to develop data processing and report. It also surely detects impurities in compounds even at trace levels. UPLC combines with demand mass LC/MS, has been successfully working for the identification of the drug and endogenous metabolites.

Compound Library Maintenance

The use of the fast-scanning MS down with the throughput of the UPLC System's distant status monitoring software allows chemists to obtain high-quality comprehensive data around their compound in the shortest possible time frames. This, incorporate with intelligent open-access software, allows manufacture informed decisions faster, and better keep up the needs of the modern drug discovery activity[23-30].

CONCLUSION

The UPLC extends and expands the utility of chromatography. The main advantage is a reduction of analysis time, which also meant reduces solvent consumption. The time spent improve new methods can also be greatly reduced. In the HPLC the column length is more than that of UPLC also particle size is less this results in an increase in plate number which gives more accurate separation. Due to increase pressure, the retention time also got reduced. So by taking into consideration all these points the UPLC is found to be more sensitive, more precise. The tailing factors and resolution were similar for both techniques. The peak area repeatability (as RSD) and peaks retention time repeatability (RSD) were also similar for both techniques. A negative particular of the UPLC could be the higher backpressure than in conventional HPLC. This backpressure can be decreasing by increasing the column temperature. Overall, it seems that UPLC can offer a significant improvement in speed, sensitivity, and resolution compare with conventional HPLC.

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Table 1. Examples of some common LC system issues intentionally induced that can be diagnosed with Waters Neutrals QCRM.

PROBLEM	PROBLEM DESCRIPTION
1	Poor column performance
2	Leak in pump
3	Poor check valve performance
4	Improper column fitting connections
5	Air bubble in system
6	Error in mobile phase preparation

Table 2. Data gathered during system benchmarking, demonstrating a well operating system with a low retention time %RSD (n=45).

		ACETONE	NAPHTHALENE	ACENAPHTHENE
Benchmarking data (n = 45)	Retention time average (min)	0.323	1.633	2.893
	Retention time %RSD	0.690	0.440	0.440
	USP Tailing factor	1.180	1.130	1.080
	USP Plate count	3144	11009	10436

Table 3. Data collected during the use of a failing column and after replacement of the column (n=9).

		ACETONE	NAPHTHALENE	ACENAPHTHENE
Failing column (observed during problem)	Retention time (min)	0.319	1.574	2.770
	USP tailing factor	1.290	1.040	1.010
	USP plate count	1043	1458	1433
Failing column (After repairs)	Retention time average (min)	0.323	1.631	2.893
	Retention time %RSD	0.670	0.460	0.440
	USP Tailing factor	1.170	1.130	1.090
	USP plate count	3152	11001	10531

Table 4. Data collected for a malfunctioning pump with a minor leak and the repaired pump (n=9).

		ACETONE	NAPHTHALENE	ACENAPHTHENE
Leaking fitting at Pump Outlet (observed during problem)	Retention time (min)	0.376	1.832	3.206
	USP tailing factor	1.160	1.140	1.080
	USP Plate count	3438	9348	8516
Leaking fitting at Pump Outlet (After repairs)	Retention time average (min)	0.323	1.631	2.893
	Retention time %RSD	0.680	0.450	0.440
	USP Tailing factor	1.180	1.120	1.070
	USP Plate count	3148	11020	10421

Table 5. Data collected from the system with a bad check valve and a good check valve (n=9).

		ACETONE	NAPHTHALENE	ACENAPHTHENE
Bad check valve (observed during problem)	Retention time (min)	0.374	1.805	3.156
	USP tailing factor	1.170	1.070	1.020
	USP plate count	3103	8768	8783
Bad check valve (After repair)	Retention time average (min)	0.323	1.631	2.893
	Retention time %RSD	0.680	0.470	0.440
	USP tailing factor	1.160	1.140	1.070
	USP plate count	3157	11025	10511

Table 6. Data collected with improper and proper column connection(n=9).

		ACETONE	NAPHTHALENE	ACENAPHTHENE
Improper Seating of column Outlet tubing (observed during problem)	Retention time (min)	0.385	1.669	2.815
	USP tailing factor	1.140	1.200	1.170
	USP plate count	3159	8685	8659
Improper Seating of Column Outlet tubing (After repairs)	Retention time average (min)	0.323	1.631	2.893
	Retention time %RSD	0.670	0.450	0.440
	USP Tailing factor	1.160	1.080	1.070
	USP plate count	3220	10980	10438

Table 7. Data collected with and without an air bubble in the LC system. The air bubble was removed by priming the mobile phase pump.

		ACETONE	NAPHTHALENE	ACENAPHTHENE
Air Bubble in system(Observed during system)	Retention time (min)	0.471	2.066	3.436
	USP Tailing factor	1.120	1.160	1.110
	USP Plate Count	4408	10116	9616
Air Bubble in system (After repairs)	Retention Time Average (min)	0.323	1.631	2.893
	Retention Time %RSD	0.690	0.460	0.440
	USP Tailing Factor	1.15	1.06	1.09
	USP Plate Count	3189	11202	10449

Table 8. Data collected from the injections of Neutrals QCRM with different mobile phase compositions

		ACETONE	NAPTHALENE	ACENAPHTHENE
52% ACN used in separation	Retention time (min)	0.336	1.295	2.148
	USP tailing factor	1.130	1.070	1.080
	USP plate count	3290	9323	9144
48% ACN used in separation	Retention time (min)	0.358	2.035	3.690
	USP tailing factor	1.150	1.080	1.080
	USP plate count	3124	8818	8974
50% ACN (recommended conditions used in separation)	Retention time average (min)	0.323	1.632	2.893
	Retention time %RSD	0.680	0.430	0.440
	USP Tailing factor	1.140	1.050	1.060
	USP Plate count	3297	11402	10520

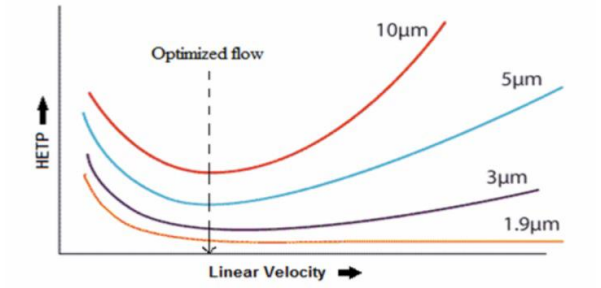

Figure 1: Van Deemter plots for various particle sizes.

Figure 2: Ultra Performance Liquid Chromatography

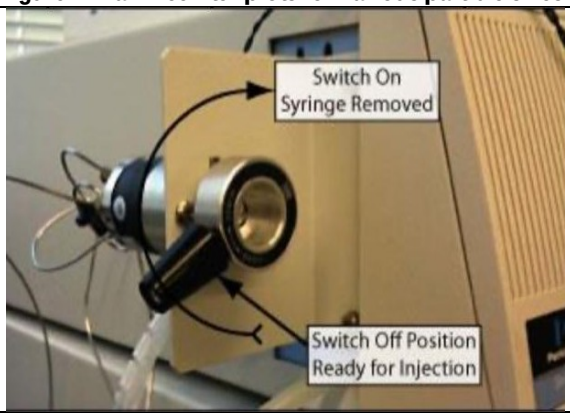

Figure 3: Sample Injection

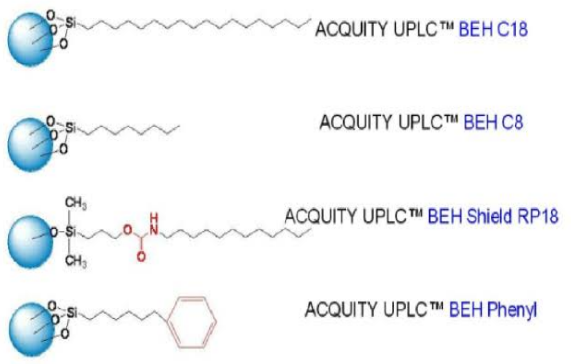

Figure 4: Phases of UPLC Columns

Figure 5: UV Detector

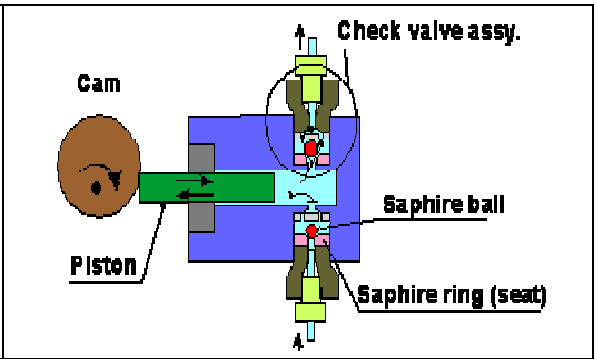

Figure 6: Reciprocating piston pumps

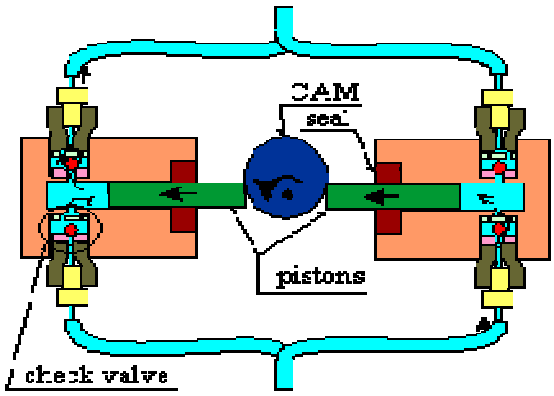

Figure 7: Dual piston pumps

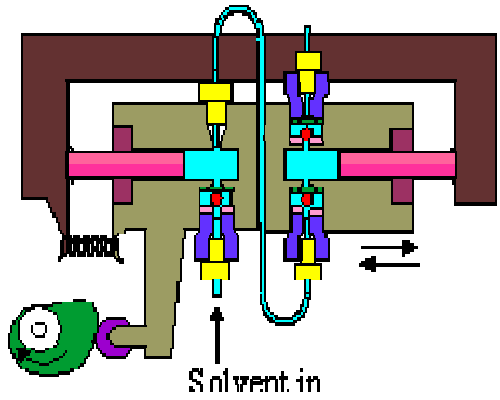

Figure 8: Dual head Reciprocating pumps

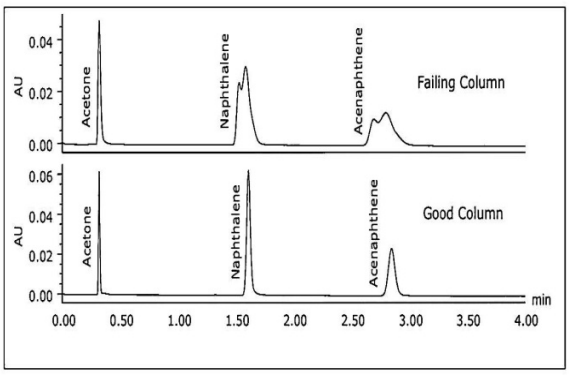

Figure 9. Separation of the Neutrals QCRM on the failing column and a good column.

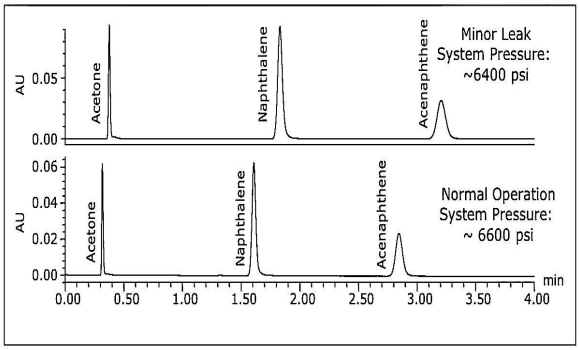

Figure 10. Separation of the Neutrals QCRM comparing a malfunctioning pump with a minor leak to a normal operating pump

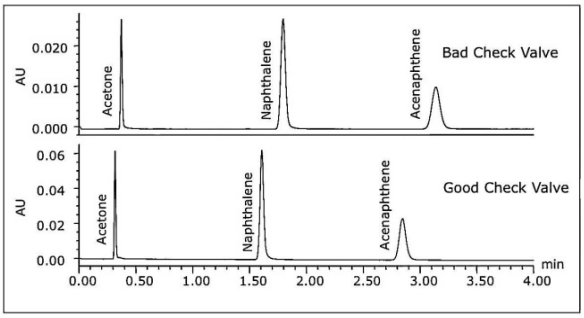

Figure 11. Separation of the Neutrals QCRM on a system with a bad check valve and good check valve

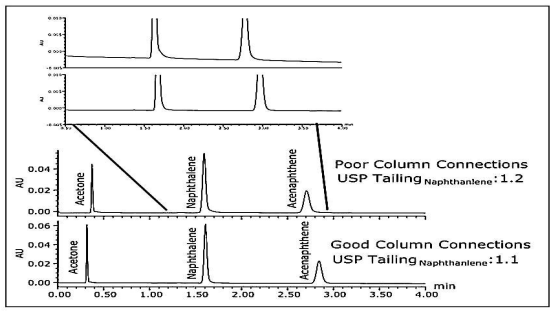

Figure 12.Separation of the neutrals QCRM with and without proper column connections.

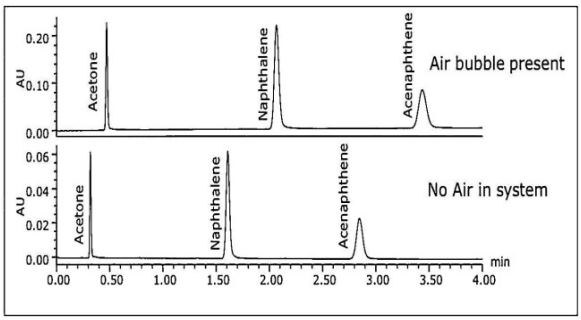

Figure 13. Separation of the natural QCRMwith and without an air bubble in the system.

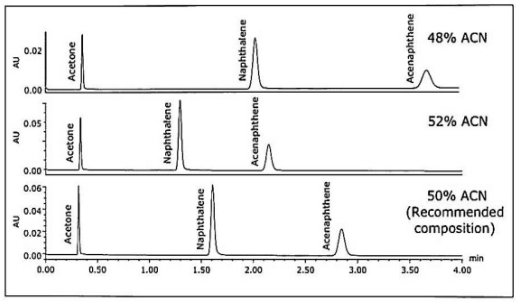

Figure 14. Impact of mobile phase strength on the separation of the neutrals QCRM.

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RESEARCH ARTICLE

Prescribing Pattern of Antihypertensive Medications among Post Menopausal Women with Hypertension in A Tertiary Care Teaching Hospital

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ABSTRACT

The drug prescription pattern in menopause is a complex. Knowledge of prescription pattern and thus the rational utilization of drugs will help overcome the irrational therapy. This study was aimed to evaluate the prescribing pattern of antihypertensives among postmenopausal women. A prospective observational study was conducted in the Department of General Medicine at Karuna Medical College Hospital, Palakkad for a period of six months (October 2019 to March 2020). Approval of the Institutional Ethical committee was obtained prior to commencement of the study. Women with self reported cessation of menstruation for >12 consecutive months with or without co morbid diseases. Post menopausal women who was done hysterectomy, oophorectomy. A self designed Data collection form was prepared as a tool for collection of data like demographic profile, past medication history, family history, age of menopause and life style factors. A total of 287 hypertensive post menopausal women met the inclusion criteria. In the present study, monotherapy was prescribed with 50% of patients and combination with 5% of patients. The commonly prescribed anti-hypertensive agents is Calcium channel blocker (39.8%), followed by Angiotensin receptor blockers (31.4%), Beta blockers (18.1%), Angiotensin converting enzyme inhibitors (4.2%) and Diuretics (5.6%). The use of calcium channel blockers ($p<0.00001$) and diuretics ($p<0.00001$) were more in combination therapy than the monotherapy. The prescribing pattern of antihypertensives among the post menopausal women is needed to achieve the goal and reduce the mortality.

Key words: Post menopausal women, hypertension.

INTRODUCTION

Menopause is a normal physiological process which is characterized by the permanent cessation of menses in women as a result of reduced ovarian hormone secretion usually between the ages of 45 and 55 years [1]. Menopause is associated with a reduction in estradiol and a decrease the estrogen to testosterone ratio and it leads to endothelial dysfunction and increases in body weight which causes an increase in sympathetic activation. Sympathetic activation can result in increased renin release and increases in angiotensin II (Ang II) and endothelial dysfunction is accompanied by reductions in NO and increases in endothelin, which both contribute to salt sensitivity of BP, which is common in PMW [2]. Studies have reported a higher prevalence of hypertension in postmenopausal than in premenopausal women and also evaluated changes in blood pressure (BP) across the menopausal transition which is characterized by menstrual cycle irregularities, changes in ovarian hormone concentrations, and increased risk for the development of cardiovascular disease (CVD). It can last for months or years (average, 4 years) depending on the individual [3]. Hypertension is one of the leading risk factors for CVD. Aging in both men and women is characterized by increases in blood pressure (BP), but the age-related increases are more rapid in women than in men, and the prevalence of hypertension in postmenopausal women is higher than in men [4].

The drug prescription pattern in menopause is a complex. Knowledge of prescription pattern and thus the rational utilisation of drugs will help overcome the factors like polypharmacy, inappropriate medicine use, co-morbid conditions, pharmacokinetic and pharmacodynamic variability, non compliance and irrational prescription pattern. Previous studies available analysing anti-hypertensive drug prescription pattern in various age groups however, there is paucity of data regarding antihypertensive prescription trends among PMW [5]. This study was aimed to evaluate the prescribing pattern of antihypertensives among postmenopausal women.

METHODS

A prospective observational study was conducted in the Department of General Medicine at Karuna Medical College Hospital, Palakkad for a period of six months (October 2019 to March 2020). Approval of the Institutional Ethical committee was obtained prior to commencement of the study.

Inclusion criteria: Women with self reported cessation of menstruation for >12 consecutive months with or without co morbid diseases.

Exclusion criteria: Post menopausal women who was done hysterectomy, oophorectomy. A self designed Data collection form was prepared as a tool for collection of data like demographic profile, past medication history, family history, age of menopause and life style factors. Some clinical and therapeutic data such as systolic blood pressure (SBP), diastolic blood pressure (DBP) and antihypertensive drugs were extracted from the case file of the patients. Statistical analysis was performed by using graph pad prism. Chi square test was applied to analyze the categorical variables and $P < 0.05$ was considered statistically significant.

RESULT AND DISCUSSION

A total of 287 hypertensive post menopausal women met the inclusion criteria. The baseline characteristics of study population are shown in Table 1 and of these, 271 (88.7%) patients having the age of ≥ 45 yrs. The half of post menopausal women had cardio vascular disease and cerebro vascular disease and the average mean age of study population was 46.8±2.51 and the mean age at menopause was 59.48 ± 11. In the present study, monotherapy was prescribed with 50% of patients and combination with 5% of patients. The commonly prescribed anti-hypertensive agents is Calcium channel blocker (CCB) 57 (39.8%), followed by Angiotensin receptor blockers (ARB) 45 (31.4%),

Beta blockers 26 (18.1%), Angiotensin converting enzyme inhibitors 6 (4.2%) and Diuretics 8 (5.6%) (Table-2). Previous study showed that hypertensive women had more comorbid conditions than did nonhypertensive women, and women with comorbidities were more likely to be treated pharmacologically. Diuretics were used by 44.3% of hypertensives either as monotherapy or in combination with other drug classes. As monotherapy, calcium channel blockers were used in 16%, angiotensin-converting enzyme inhibitors in 14%, b-blockers in 9%, and diuretics in 14% of the hypertensive women. Diuretics as monotherapy were associated with better blood pressure control than any of the other drug classes as monotherapy [6].

The combination therapy (two drugs) wise distribution among study population was showed in Table-2. In these Calcium channel Blocker + Diuretics was prescribed with 37 (29.8%), Angiotensin Receptor Blocker + Diuretics with 36 (29%), Beta Blocker + Diuretics with 25 (20.1%) and ACE Inhibitors+ Diuretics with 10 (8%) of patients. Angiotensin Receptor Blocker + Beta Blocker and Angiotensin Receptor Blocker + Calcium channel Blocker were prescribed with 6% of patients. In three drugs combination therapy showed that Angiotensin Receptor Blocker + Diuretics+ Beta Blocker with 12 (60%), Beta Blocker + Diuretics+ Calcium channel Blocker 4 (20%), ACE Inhibitors+ Diuretics+ Beta Blocker and Calcium channel Blocker + Diuretics+ ACE Inhibitors with 2 (10%).

The use of combination therapy is encouraged by JNC (Joint National Committee), WHO/ISH (World Health Organization/the International Society of Hypertension) and ESC/ESH (European Society of Cardiology/European Society of Hypertension) guidelines, which state that small doses of different classes of antihypertensive drug are more beneficial than a high dose of a single drug. Large clinical trials also demonstrated that most patients with hypertension can reach and maintain adequate BP control only with use of multiple antihypertensive drugs [7]. Pattern of antihypertensive based on type of therapy showed in table 3. The use of calcium channel blockers ($p<0.00001$) and diuretics ($p<0.00001$) were more in combination therapy than the monotherapy. A number of national and international guidelines for the management of hypertension have been published highlighting mono- or combination therapy according to the BP levels and associated comorbidity. Worldwide, hypertension treatment strategies have varied widely over time in terms of initial drug of choice from diuretic to ACEI/ ARB/ CCB, from monotherapy to low dose combination single pill therapy [8]. Calcium channel blockers (CCBs) may be useful to diabetics, particularly as part of combination therapy to control BP as well as reduce the risk of cardiovascular disease (CVD) events in diabetics. In our study 26% of hypertensive post menopausal women had diabetes mellitus [9].

CONCLUSION

Blood pressure is typically lower in premenopausal women than in men. However, after menopause, the prevalence of hypertension in women is higher than it is in men. Hypertension is a major risk factor for cardiovascular disease in women and men. Furthermore, there is evidence that blood pressure may not be as well-controlled in women as in men, despite the fact that most women adhere better to their therapeutic regimens and medications than do men, and have their blood pressures measured more frequently than do men. The prescribing pattern of antihypertensives among the post menopausal women is needed to achieve the goal and reduce the mortality.

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Table: 1: Clinical characteristic of study population

S.No	Parameters	Number of Patients
1	Mean age of menopause	46.8±2.51
2	Mean age	59.48 ± 11.1
3	Age	
	>45 years	16
	≤ 45 years	271
5	Co morbidities	
	No co morbidity	74
	One co morbidity	44
	Two co morbidities	151
	Three co morbidities	18
6	Types of co morbidity	
	Diabetes Mellitus	76
	Dyslipidemia	33
	Coronary artery disease	54
	Stroke	18

Table: 2. Distribution of class of antihypertensive among study population

S.No	Class of Drugs	N(%)
	Monotherapy (n=143)	
1	ACE Inhibitors	6 (4.2%)
2	Angiotensin Receptor Blocker	45 (31.4%)
3	Beta Blocker	26 (18.1%)
4	Calcium channel Blocker	57 (39.8%)
5	Diuretics	8 (5.6%)
	Combination Therapy	
	Two drugs Combinations (n=124)	
1	ACE Inhibitors+ Diuretics	10 (8%)
2	Angiotensin Receptor Blocker + Diuretics	36 (29%)
3	Beta Blocker + Diuretics	25 (20.1%)
4	Calcium channel Blocker + Diuretics	37 (29.8%)
5	Angiotensin Receptor Blocker + Beta Blocker	06 (4.2%)
6	Angiotensin Receptor Blocker + Calcium channel Blocker	06 (4.8%)
7	Calcium channel Blocker + Angiotensin Receptor Blocker /	04 (4.8%)

	Beta Blocker	
	Three Drugs Combinations(n=20)	
1	Angiotensin Receptor Blocker + Diuretics+ Beta Blocker	12 (60%)
2	ACE Inhibitors+ Diuretics+ Beta Blocker	2 (10%)
3	Beta Blocker + Diuretics+ Calcium channel Blocker	4 (20%)
4	Calcium channel Blocker + Diuretics+ ACE Inhibitors	2 (10%)

Table: 3. Pattern of antihypertensive on type of therapy

S.No	Antihypertensive drug class	Monotherapy (n=144)	Combination therapy (n=143)	P value
1	ACE Inhibitors	6 (4.2%)	14 (9.8%)	0.833
2	Angiotensin Receptor Blocker	45 (31.4%)	62 (43.3%)	0.0118
3	Beta Blocker	26 (18.1%)	53 (37%)	0.026
4	Calcium channel Blocker	57 (39.8%)	51 (35.6%)	<0.00001
5	Diuretics	8 (5.6%)	124 (86.7%)	<0.00001
	Total	144	304	-

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RESEARCH ARTICLE

Structural, Textural and Geochemistry Characterization of Alkaline Syenite from Pakkanadu and Pikkili Alkaline Carbonatite Complex in Southern Granulite Terrain, India

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ABSTRACT

The Syenite were formed during the Late Proterozoic in the northern part of South India and displays close relationship with a diverse group of Peninsular Gneissic complex and contains many rock formations from mafic to ultramafic composition. This ultramafic complex corresponds to the alkaline magmatism, which were intruded into the country rock and widely distributed at Kamaneri, Chindamaniyur and Semmandapatty in Salem districts and Pikkili surrounding areas in Dharmapuri districts of Tamil Nadu. Twenty samples were collected randomly to assess the textural characteristics and trace elemental concentration in the rocks of Pakkanadu alkaline complex. The textural orientation closely confirms the textural properties of Syenite rock, such as leucocratic, medium to coarse grain, equigranular alkaline rock showing hypidiomorphic texture and consisting of K-feldspar (microcline), pyroxene, amphibole with accessory minerals such as plagioclase feldspar, magnetite, sphene, zircon, calcite and apatite. The petrography results also show that both crustal and mantle-derived rock compositions and their texture demonstrate their source. The ferromagnesian and transitional trace element data reveal that magma derived from a Sub continental lithospheric mantle source with ultramafic affinity. The elemental distribution is mainly controlled by the process of magmatic differentiation.

Keywords: Alkaline rocks; Textural properties; Trace elements; Geochemistry.

INTRODUCTION

The Southern Granulite Terrane is a collection of crustal blocks, which were integrated together at different times from Neoarchean to the most recent Neoproterozoic – Cambrian [1, 2]. The Sothern Granulite Terrain is facilitating a

wide assortment of unmetamorphosed with great extent of undeformed alkaline magmatic suites including syenites, ultrapotassic rocks, carbonatites, lamproites and shonkinites, which are occurring as intrusives, lensoidal, dykes and association that are generally within or proximal to major paleo-suture/shear zones or metamorphosedfaults [3]. The northern part of Southern Granulite Terrain experienced profound crustal fracture and distinctive lithology, structure by virtue of magmatic and metamorphic history viewed as Dharmapuri Suture Rift Zone (DSRZ) [4, 5]. The extension of DSRZ is controlled by different structural features like Jawadi hill lineament in the east, Mettur-Palakkadu lineament in the west, in the north Palar lineament and Palghat-Cauvery shear in the south. Evolution history of DSRZ is divided into two phases; I) Collisional structural stage and ii) Rifting structural stage. Prior stage of two crustal squares on either side stitching and welding from DSRZ after began to proceed with reactivation of shear zone and improvement of tensional crack just as basic pluton emplacement along NNE-SSW, N-S and ENE-WS trend [6, 7].The alkaline complex structurally associated with metamorphosed hornblende biotite gneissic rock in the Pakkanadu and Pikkili region [8]. Previously numerous of researchers have reported that structural aspects of Pakkanadu and Pikkili alkaline complex [9, 10, 11, 12, 13]. However, the structural interpretation of alkaline complex in Pakkanadu and Pikkili is more complex to understand the origin without petrogenetic characterization. In this present study, we have attempted to understand characterization of alkaline silicate melts and magma differentiation with help of important trace elements concentration and structural signatures in the Pakkanadu and Pikkili alkaline complex.

Study area

The Pakkanadu and Pikkili alkaline Complex belongs to South Indian Granulite Terrain (SGT), which is situated with coordination of N-11º47'09.5" - E77º59'20.8" and N-12º15'24.2"- E78º01'25.6" respectively. Geologically the Pakkanadu alkaline complex comes under Neo-Proterozoic age and mainly composed by Syenite, Carbonatite, Hornblende biotite gneiss and Pyroxinite rock types. The series of Pikkili alkaline complex comes under Paleoproterozoic age and mainly composed by Syenite, Migmatite, Hornblende Biotite Gneiss and Charnockite rock types (Fig.1). The minor foliation and lineation occurs in the Syenite body. The different size width of quartz veins found in the Pakkanadu alkaline complex. The Pikkili village is situated near 16km NW of Dharmapuri town, forms a set of linear residual hills made up of syenite in and around Pikkili village with NNE-SSW trend. The major xenolith structures present in the Pikkili Alkaline Complex. The charnockite body trends N-S direction and the direction of lineation or direction of elongation of mineral grains are in NW-SE 110°.

MATERIAL AND METHODS

Detailed field study was carried out by using topo sheet (58 E/13) published by Geological Survey of India. The sampling stations were marked by geographical coordinates using GPS(Model: GARMIN 76 CSx). The fresh rock samples were collected from the ideal field exposure for laboratory study. The structural features and field relationship of alkaline outcrop was studied in field itself. The collected rock samples were processed for thin section preparation and petrographic study examined by the petrological microscope LEICA-Model DM 2700P, in Department of Geology, Periyar University. The trace elements like Fe, Mn, Pb, Zn, Cu, Cr, Co and Ni were analyzed by AAS (Model: Perkin-Elmer AA700).

RESULT AND DISCUSSION

Petrography: Commonly the rocks from the Pakkanadu alkaline complex contain alkali feldspar mainly orthoclase and microcline, pyroxene, amphibole with opaque. Sphene, apatite, quartz, zircon are the common accessory minerals. Microcline is the most dominant member of the alkaline complex. Under the microscope, Microcline grains are characterized by medium to coarse-grained, equigranular, colorless, non-pleochroic, low relief, and often exhibithypidiomorphic texture. Microcline shows Tartan twinning, Poor to moderate relief, colorless, two cleavages intersecting nearly at right angles on a (100) section. Anisotropic extinction angle 5^0. Coarse-grained pyroxene is

brownish to green colored euhedral, low pleochroic in pink to greenish. Clinopyroxene show parallel extinction, and orthopyroxene show exsolution lamellae. Pyroxene is identified as 90^0 cleavage angle of orthopyroxene. Orthopyroxene show high relief, pleochroic, and pink in color. Amphibole present in green colored subhedral grains, olive-green to dark green pleochroism, two sets of prismatic cleavage intersect cleavage angle at 56°, moderate to high relief, anisotropic. Biotite grains are green in color, brown to black, pleochroic with parallel cleavage. Apatite minerals present as small amounts of the accessory mineral, Fe-Oxides present as opaque mineral. Sphene and zircon occur as minor accessory. Sphene mineral identified by diamond shaped well develop euhedral crystal. Microscopically sphene is brown in color, pleochroic, high relief, twinning present in simple twinning. Euhedralsphene is intergrowth within alkali feldspar (Fig.2).

Geochemistry: The signature of trace element concentration can be utilized to understand the magmatic processes [15, 16, 17]. The concentration of trace elements such as Fe, Mn, Cr, Cu, Pb, Zn, Ni and Co of Pakkanadu and Pikkili alkaline complex are presented in Table 1. Based on the trace element concentration present in alkaline complex of study region show the following sequence of concentration in the increasing order as Fe>Mn>Cr>Ni>Zn>Co>Pb>Cu. The higher concentration of Fe and Mn confirms that presence of pyroxene and amphibole group of minerals in the alkaline complex of the study region. Moderate concentration of Pb suggest that presence of K-feldspar in magma composition. The transitional elements like Ni, Cr, Cu, and Co show the moderate signatures due to the lack of mafic minerals in alkaline complex. The geochemical distribution plots of the alkaline and mafic rocks are plotted (Fig. 3), the plots mostly indicate depleted and enrichment pattern and which reveals that magmatic differentiation play a vital role in the Pakkanadu and Pikkili alkaline complex area.

CONCLUSION

The field characterize of Pakkanadu and Pikkili alkaline plutons and some outcrops were observed from northern part of the study region. The field structural orientation inferred that emplacement of primary, secondary structure development, deformation and metamorphic history of the alkaline complex during the alkaline magmatism. The petrography and geochemistry studies reveals that origin of alkaline rocks, peterogenitic characterization and cooling history of alkaline magma. The ferromagnesian and transitional trace element data reveal that magma derived from a Sub continental lithospheric mantle source with ultramafic affinity. Overall the elemental distribution in the study region is mainly controlled by the process of magmatic differentiation.

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Table 1. Trace elements concentration (ppm) of Pakkanadu and Pikkili alkaline rocks.

S.No	Fe	Mn	Ni	Cu	Cr	Co	Pb	Zn
1	12939	723	51.7	12.1	243.3	34.7	14.4	65.4
2	12889	621	45.3	20.9	213.3	29.8	20.4	69.6
3	8392	57	11.2	1.4	117	5.1	0.6	9.3
4	10676	309	11.3	1.1	23.9	2.3	0.3	8.2
5	1163	41	14	0.5	34.9	3.3	0.1	3.4
6	9798	301	68.1	51.5	161.9	35.3	36.3	62.4
7	12523	436	85.2	18.8	252.3	42.5	44.2	98.4
8	13964	890	1299.2	15.4	2945.2	127.6	40.7	82.9
9	13912	764	1205.2	15.6	1194.2	119.3	45.4	54.7
10	13718	806	1230.9	15.7	1932.7	155.4	40.1	66.9
11	14128	882	1238.4	11.6	1943	121.6	37.8	70.5
12	12675	537	118	51.8	224.8	39.6	27	116
13	14841	1308	152.9	122.8	556.1	66.5	15.2	155.4
14	14376	1134	315.4	85	1120.2	66	31.6	110.7
15	14254	1296	361.6	36.3	1234	74.5	37.8	98

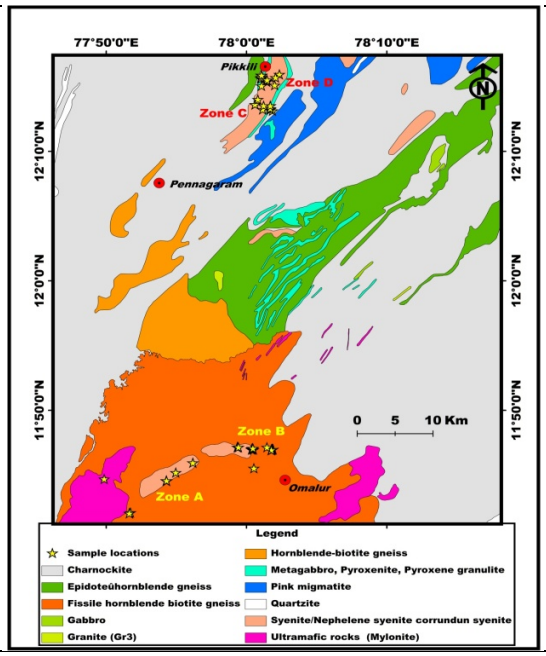

Figure 1: Location map of Pakkanadu and Pikkili alkaline complex

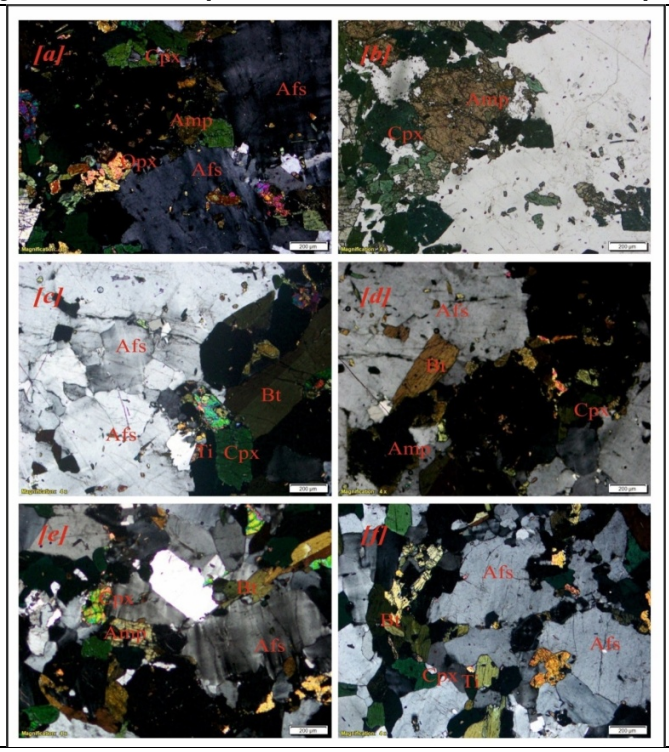

Figure 2: Micro photographs show (a-d), medium to coarse-grained alkali feldspar, which exhibits hypidiomorphic texture. Subhedral to euhedral amphibole shows moderate pleochroism with elongated fibrous biotite. e .Magnetite with Allanite is present in opaque. f. Amphibole rims are developed in pyroxene.

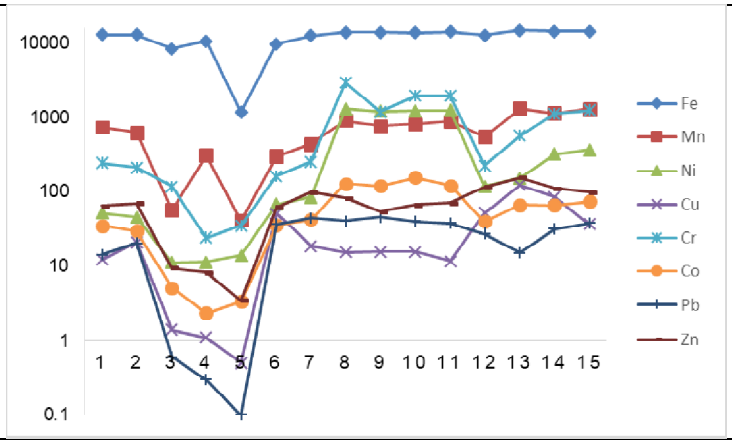

Fig 3: Trace elements concentration diagrams of Pakkanadu and Pikkili alkaline complex

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RESEARCH ARTICLE

To Be and Not to Be- Individual Exclusion of A Single Mother in the Book *The Pregnant King*

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ABSTRACT

In a patriarchy governed society single mothers are the historically disadvantaged group who keep struggling for their identity and existence. This study is about the magnitude of challenges Shilvati- the Regent Queen faced while keeping her dreams alive, in the book *The Pregnant King*. The emotional and psychological status of her in the social and political sphere and the depression and traumatic experiences, she experienced after being removed from the throne are explored here. The need of creating choice or the balance between her own identity or her responsibilities, the perception of society towards her and her own struggle as a mother and as a Queen are studied in reference to the male chauvinist society. The theory of gender trouble by Judith Butler is used to deconstruct this concept with modern relevance too. The study in detail, analyses the need of welcoming the rainbows which are rare in the black and white set binary normative society.

Keywords: Patriarchy, Single mother, Self and Identity, Gender Trouble.

INTRODUCTION

Gender Conflict has been one of the critical issues in current era, especially in Indian society. Generally, from ancient times till today the world has been perceived in binary opposition which consign the social structure only in heteronormative ideal (the rigid notion of being a man or a woman, social practices of how a woman or man should behave, act and internalize their identities). A world which has moved beyond sheer survival instinct because of its ever-growing awareness towards quality of life is more thoughtful having a vision of better living. Factionist, genderization, majoritarianism, conditioning of mind for an order in society, role and power conflicts within social order, dominance of leadership shaping the opinions, meritocracy etc. are the things of past, we are a comparatively enlightened humanity today. The significance of freedom of opinions can be strongly felt on Social media platforms

which are facilitating the voices of common masses on these related issues, giants like Instagram, National Geographic channel and others are actively supporting the humanity first and individual freedom expressions helping the mass sharing of common perceptions. With course of time, the Contemporary Post-modernist Indian English writers have started interrogating the authority, stereotypes, and sexiest values, challenging the foundations of the social practices that brace the old binary model of sex or gender. These writers, through their writings, shuffle the power hierarchy and reconsider these social practices, demulcenting the gender distinctions. The change of sex and gender reversal has been a widespread phenomenon in traditional and modern era and it also has an important place in the domain of Indian mythology and society. This study is based on contemporary literary text from the epic *Mahabharata* presented in the book *The Pregnant King (2008)* written by Devdutta Pattanik. It is a contemporary retelling of some tales of non-normative sexual identities and raises several questions which need to be pondered on like -What happens if one desires to experience life regardless of his/her gender? Should a deserving female be denied ruling because of her sex?

It is as an attempt to reinterpret the gender and psychological issues which testifies unawareness of a double marginality, an inequality felt by the victims both in terms of gender and psyche. It redefines the roles and parameters of these underrated characters as a challenge in the society, the embodied form of action, knowledge, devotion and power and the status of gender dichotomy in present Indian society.

METHODOLOGY

This study consist of close reading, reinterpretation and in-depth study of the reinterpreted works of modern writers and the old epic *Mahabharata* in reference to female characters. This research paper also considers the critical material and reviews available on various sites and books.

The Politics of Dichotomy

Sex and gender which are often used interchangeably, are in fact entirely different concepts. Sex refers to the biological aspects of an individual as determined by their anatomy, produced by chromosomes, hormones and their interactions. Gender is a social construction related to behaviors and qualities labeled with masculinity and femininity. In the process of socialization, children are introduced to certain roles that are typically linked to their biological sex which explain them how man and woman are expected to act and how they should behave. Like in most of the patriarchal culture masculine roles are usually associated with strength, aggression and dominance. While females are restricted to passivity, nurturing and subordinate roles.

What should be considered Normal?

Heteronormative refers to a worldview that perceives heterosexuality as the normal/acceptable or preferred sexual orientation. Heteronormativity describes how social institutions and policies reinforce the presumption that people are heterosexual and that gender and sex are natural binaries.

Can Gender Be Fixed?

It is an umbrella term for people whose gender identities are different from their sex (assigned at birth). A person who is male (sex assigned at birth) might not have same sense of self or internal experience of gender. Or a female can feel internally like male attributes as gender experiences.

Gender Queerness

The term ‘Queerness’ analyses and conceptualizes the existing imposing ideals of social norms and taxonomies. Queer Theory's overarching goal is to be sought out as a tool to deconstruct the existing monolithic ideals of social rules and rigid notions which do not sufficiently explain different attitudes, behaviors, or conditions of individual experiences. It analyzes the correlation between power distribution and identification while understanding the

multifarious facets of oppression and privilege. "Queer Theory is seen as applicable concepts that provide a framework to explore these issues rather than as an identity to those in the community. Queer is an umbrella term for those not only deemed sexually deviant, but also used to describe those who feel marginalized as a result of standard social practices. It is a site of permanent becoming" (Giffney, 2004).

Transgression in Gender Dichotomy

By transgressing the seemingly fixed notions like sexuality and gender, queer theory exposes a revolutionary new way of analyzing human identity itself. Through the works of intellectual theories like post- structuralism and the theorists like Judith Butler and Simone de Beauvoir, the queer theory challenges heterosexuality and the fixed notions of sexuality and gender and analysis the human identity in a radical way. "There is no reason to assume that gender also ought to remain as two. The presumption of a binary gender system implicitly retains the belief in a mimetic relation of gender to sex whereby gender mirrors sex or is otherwise restricted by it, "Judith Butler 1993 (*Gender Trouble: Feminism and the subversion of Identity*). The work raises the questions of gender dichotomy through the character of Shilavati "given a man's head and a woman's body" who had a desire and signs of intelligence to become a ruler. But being a girl, she was destined to be a wife, a mother but not a ruler.

A Woman with the Man's Head

Shilavati was the eldest daughter of Ahuka, king of Avanti. Butinspite of being a girl her dreams were quite opposite or queer of what was prescribed for a female by the society. She had the qualities of being a great ruler, but her father and the contemporary society thought it unfit for a female to rule despite of her qualities. On the other hand, Nabhaka, the younger brother of Shilavati, was destined to become a king, was least interested in becoming a king. He wanted to pursue music and arts instead of learning dharma shastra. His conflict of duty and desire is expressed by the questions he has raised, "If my whole life has been decided for me, then why did Prajapati give me a heart? Why did he make me dream? Why does he bring music into my heart? When would I live my own life?" (Pattanik, 2008, p. 26). The pain of dreams crushed on the altar of society was unbearable for both. They knew that just as a man's destiny was bound to his lineage, in the same way a woman's destiny was bound to her body. Both were determined at birth and was immutable and they had to sacrifice their dreams for the sake of society. King Ahuka's heart ached for his children. He found himself stucked in a queer situation. His son Nabhaka who did not want to be king and his daughter Shilavati who would not be allowed to be a king. They had to repay their debts whether they liked it or not according to their set roles in society. He told his wife about Shilavati,

"She thinks clearly. She thinks deep. Life has spewed out a twisted fate for my daughter, given her a man's head and a woman's body." (Page 28) When Prasenjit, husband of Shilvati died early, she got an opportunity to rule the kingdom. But everyone was stunned that how can a female rule!

"A man! How can a woman rule? It is like asking a man to bear children." (Page 21)

The present scenario witness to the brilliance of women in politics time, and again.

There have been influential female political leaders like Sushma Swaraj, Sheila Dikshit, Soniya Gandhi, Mamta Banerjee, Jaylalita, Mayawati, VasundharaRaje and many more who have contributed to the development of the country. Then why can't women rule the world? The Patriarchy has always confined women to domestic roles and disallowed authority in the public domain. The leadership positions in society, politics, religion or economic sector was and has been considered suitable for males only. How can such system allow Shilavati to rule? But while no other choice left, she was made the regent to the throne till her son was ready to rule. The deep roots of women's subordination in the patriarchal civilization are always supported by binary gender categories and roles. And anything other than these prescribed roles was taken as a threat or transgression to the society so were/are sanctioned, suppressed or threatened.

Queer theorist Michael Warner defines "Social reflection carried out in such a manner tends to be creative, fragmentary, and defensive, and leaves us perpetually at a disadvantage. And it is easy to be misled by the utopian claims advanced in support of particular tactics. But the range and seriousness of the problems that are continually

raised by queer practice indicate how much work remains to be done. Because the logic of the sexual order is so deeply embedded by now in an indescribably wide range of social institutions, and is embedded in the most standard accounts of the world, queer struggles not just at toleration or equal status but at challenging those institutions and accounts." As a ruler Shilavati took very effective steps to improve the economic and political status of Vallabhi. Her supervision earned her the respect and affirmation of all the elders of Vallabhi who at first had thought that she would only be a mute figurehead. Once when Shilavati took his seven-year-old son to meet her father in law Pruthalashva in the forest, he was very contented with her rule and complimented her that, "Men are foolish. We actually believe that just because someone has a moustache they make better kings than someone with breasts." (Page 65)

But afterwards when his son Yuvanahva grew young they taunted and accused her that she had prevented her son from becoming king. Shilavati broke down on these accusations. She was brought in Vallabhi to be used and as soon as she served their purpose, they spit her out. Though she had been a great ruler, but her gender had distanced her from her subjects, "The people needed their king, their male king. Shilavati kept sobbing, feeling sorry for herself. Mandavya left her chamber in rage thinking he had misjudged her, she was made corrupt by power. She was a woman." The Angirasa laughed at his thoughts and said – "He thinks a woman should respond differently to the corrupting influence of power" (Page 180)

Even after her death her life was recorded by Yama as a dutiful daughter, obedient wife and mother of Yuvanasva without considering her long and peaceful reign as a ruler. Being curious when Yuvanshua asked the ghosts that how did Yama describe his mother in his account book? They replied- "As a dutiful daughter of Ahuka, loving sister of Nabhaka, obedient wife of Prasanjit and doting mother of Yuvanshua."

"That's it?" a deep pain gripped Yuvanshua's heart. "No mention of her long and glorious reign."
"No. That would make her a king and confuse Yama." (page 206)
Through this gender bending characters the instances of transsexual transformation of a man to a woman or from a woman to a man are placed forth. According to Foucault," Sexuality is not a natural feature or fact of human life but a constructed category of experience which has historical, social and cultural, rather biological origins".

Why Reaching A Rainbow is so Complicated?

Demolishing authority and stereotypes these characters represent the overlooked disturbed tales which celebrate queerness concluding that gender is not an essence or a stable identity but is provisional and can never be demonstrate once and for all; they exist, as Judith Butler emphasis in her Gender Trouble, only so far as they are performed and re-performed. Being social being, human being wants stability and assurance of knowing their position in relation with others. When someone challenges the status quo of the society, this transgression is named as anti-social. It is important not to overlook the importance of individual's liberty that is willing to choose an alternative way of understanding the world. These gender stereotypes influence the mind of individuals in such manner that it dictates their future behaviour too. Therefore, anyone who has different opinion then these gender specific roles, they are subjected to ridicule if they emulate characteristics that are traditionally based on gender roles. Not only in cinema but advertisements and television shows can also see promoting these toxic ideas.

Present Situation: Usher in Gender Equality

If we talk about the situations in present India after the Pandemic lockdown, a lot difference can be seen. The Covid-19 crisis could be seen as an opportunity to challenge social dynamics in a way that benefits both woman and men, pointing to the need for a gender focused strategy in the Covid-19 response to mitigate the psychological and others effects of this pandemic. Not only the films but also television advertisements which are the most popular form of publicity, are full of such ads which shuffles these gender dichotomies. Now a would-be father can be seen cooking for the family, or a boy being taught how to wash cloths by a mother or man discussing about the ergonomic advantages of spin mops, can be seen. Though the change is not very devastating, yet a remarkable beginning can be

seen. During the lockdown husbands, fathers, sons or brothers can be seen actively participating in domestic chores of cooking, cleaning or looking after the kids, ignoring the heteronormative roles of gender. The work from home strategy has normalized the household chores for man, who earlier thought it to be not cool to do or even discuss them. Though it is ironical to make the other sex (male) feel great or applaud for them to do their own work which females have been doing since ages as if it is an essential and normal thing for them like breathing or eating. But still any change or realization in the rigid dead ideals in the name of gender dichotomy is worth mentioning as they are bringing important changes. This pandemic might usher in an equality revolution at the homes of Indian society, changing the gender equations. They will grow into more empathic, liberal beings breaking the long prevailing tragedy in the society. As Oscar wild has quoted that "All women become like their mothers that is their tragedy. No man does. That is his."

But this transgression is not that easy. There are many instances where the gender inequality has been intensified. While the social media has a flood of males working in kitchen and enjoying it, on the other hand there have been many cases of violence and sexual abuses against woman, which have intensified globally under lockdowns, excusing in the name of economic or pandemic stress.

According to The World Bank research that because of pandemic more than 12 million Indians will be driven into poverty and women being unpaid or irregular workers are going to represent this poverty which can result in the feminization of income poverty. Without any better policies, this situation will only deepen the existing social and economic inequalities for Indian Women especially single mothers. Past researches show that domestic violence cases have risen tremendously because of lockdown fostering more tension, strain in the household over security, health and jobs. According to the report by organization of Economic Cooperation and Development (OECD), women perform nearly 6 hours of unpaid work each day, while men spend a paltry 52 minutes. The present situation has increased this burden as Indian man continues to not help them in household chores.As a result of neglecting these unjust practices, grave consequences are faced by the females in this stressful time. According to a survey by OXFAM India, horrible results were seen where 41% of participants accepted it to be normal to beat a woman if she fails to prepare a meal for the man and more shocking was that one out of three man thought it or to punish a female who fails to care for children. In the report 'Mind the Gap' defining the state of employment in India the social security of female workers is identified much lower than among male workers.

CONCLUSION

Talking in respect of 21st century's vision, global societies seem more heterogeneous in structure yet more accommodating providing a naturally conducive ambience in respect of harmonizing individual polarities and freedom. In India too, there seems to be some signs of narrowing the gender gaps, increased men's participation in housework and childcare in this pandemic time, but still a long route is left untraveled before they reach to this transgression and a lot more complicated foe single mothers. From the ancient times single motherShilavati, mentioned in the pregnant king by Patnaik, till today single mothers are hardly seen without the biased glasses of dictum. Such transgender identities are subjected to criticism in ancient time till now. Simply because their gender expression is different from the normative set patterns, they are forced to go through emotional trauma of open discouragement and severe victimization. The pain and depression they face is much higher than the norms which make it difficult for them to breath. With time the understanding towards gender role is developed which feels no harm with such transgression. The modern man has likely embraced the idea of gender equality. Their changing attitude towards normative gender roles can be easily seen even in Indian houses. Modern man with his good education, financial independence has started understanding the gap on the domestic front, though dealing with the mentality of adult or aged men, is still a herculean task. This going off the rails is not concerned about 'being man' or 'being woman' but is about 'being human'.

But still this change is negligible. That is the reason why Judith Butler explaining the difference between biological sexuality and psychological gender explains that gender can't be fixed by birth, but is and can be created by a set of repeated acts within a rigid regulatory frame that congeal over time to produce the appearance of substance. These set expectations are fixed from birth. Even today there are still unwritten rules that are expected to not overstep. A female can debate and challenge the gender roles, can work outside the house but ultimately must compromise everything preserving her femininity, appearance, marriage, family honor and maternal duties. But this is not complete liberation, just few broken parts of patriarchy.

The transgression and its acceptance as normal will surely benefit everyone not just women and girls. It will also provide more chances of sound mental health, education and social protection. The need of the hour is to address gender equality and advance gender parity in education and society for these investments in qualitative human development programs that address these gender disparities and create equal opportunities should be strengthen only than the dream of progressive, healthy society will be achieved. While a lot efforts and policies are developed to reduce gender inequality, ore research needs to be done in this area. There has always been a need of representing these thought process presenting forth a more abstract and fluent understanding of human bodies, beyond the flesh to rationale human existence and revisit the tangled area of mythology with a contemporary sensibility, to deconstruct the queerness, the ideas that question fixed notions of heterosexual society.

This study helps in understanding and uprooting social structures that confined individuals into normative gender roles as well as the discrimination against transgender (queer) people who are not fit for the patriarchy's insistence confined to binary categories on sex, gender identity or sexual orientation understanding the patriarchal roots of modern civilization also serves a broader social justice agenda, and more egregious versions of oppression. By transgressing seemingly fixed notions of sexuality and gender, it demonstrates a revolutionary way of analyzing individuality over society Masculinities and femininities are being made and remade as polarized species. This paper tries to show the association between gender dichotomy and its effect on mental health of females especially single mothers. The household settings where gender inequality becomes insinuated in the cover of social life, traditions and conventions, which need to study in broader perspective of society, politics and mental health. The paper analysis that gender-dictum practices and lack of independence are interrelated to present mental health and raises a need of questioning the gender stereotypes and develop independent thinking and behaviour. There is a need of a society which does not view its status based on black and white of dichotomy, but which welcomes the rainbows. A world where each human celebrates his/her real existence, what he/she is, access to equal opportunities to grow, study and prosper. The direction of further research should not be the area of conflict and power struggle but scope of harmonizing the minor individual freedom which is subtle. The emphasis should not be on labelling and bifurcations the queer behavior, rather we as an aware society must look carefully with unifying vision.

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REVIEW ARTICLE

Life Care is a GPS Enabled Medical and Health-Care Emergency Response System

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ABSTRACT

The health-care system has considerably improved over time. However, with today's technology, it is possible to link medical services with internet systems to make the lives of patients easier. Our software, Life Care, will assist a patient in locating a specialised doctor based on their requirements, availability, distance, and consulting fees. . It is specifically created for an emergency to save the patient time looking for a specialised doctor. Life Care will locate a nearby pharmacy and check the medications that are accessible there. This system will digitise all medical records so that doctors and patients can access them from anywhere at any time. Life Care will serve as a platform for both patients and doctors, acting as a middleman between them. This concept increases the participation of small hospitals in the online system in order to improve medical services. As a result, Life Care will become the future of e-medical services, transforming the way hospitals and doctors give medical care to patients.

Keywords: Medical Emergency, Online Health Care, Web-based Medical Emergency Guidance, Location based Medical Services, Medical Information System, Healthcare Management, Smart Healthcare.

INTRODUCTION

In this day and age, society places a high value on health care. The right to proper treatment is a core human right for everyone. Medical and health-related emergencies can strike at any moment and in any place. The suggested study work has created and constructed a medical services application that will assist a patient in locating a hospital closest to their location so that they can receive suitable treatment on time. This app is compatible with any Android-based

Smartphone that has GPS capability. During an emergency, the app locates the patient and displays the location of the nearest doctor or hospital. When a patient submits an emergency request, the app alerts the doctor and the hospital, and an ambulance will be dispatched to the patient's location to transport him or her to the hospital. Before the patient comes, the notification allows the hospital staff and the doctor to prepare and be ready. The patient can sign up for a general appointment system and see a list of specialist doctors in the region. The patient can view various hospitals, doctors, ambulance services, and pharmacies (drug stores) in the chosen location, as well as filter hospitals and doctors based on their speciality. The patient can schedule an appointment with the doctor based on his or her availability. All of a patient's medical history must be entered into the app. After scheduling an appointment, the doctor can review the patient's medical history and diagnose them appropriately. The doctor will upload the reports and prescribe the prescription to the app, allowing the patient to have access to all of their records and eliminate the need for paper files. From the e-prescription, the patient can obtain medications from a pharmacy (drug store).The entire medical appointment system will be digitised with our application.

Literature Survey

Online Medical Assistance

The importance of health care in society is enormous, and this sector has been evolving and innovating in recent years to give a more efficient, automated, and digitalized framework. A web application for society must be developed so that people can keep their medical information and access it whenever and wherever they wish. Users can register as patients in the Online Health Care (OHC) system to store their medical information in the database. The framework will also include specialised doctors who will be enrolled under the enrolled clinics and hospitals and will be able to provide medical advice and prescriptions to patients. The specialised doctor has access to the patient's data and can write prescriptions. It provides a reliable method of digitally preserving data, a faster system of communication between patients and doctors, and enhanced patient security.[1] [2]

Keeping Medical Data Safe

In an emergency, being unable to access a patient's medical history can result in death.To gain access to the data, a variety of technologies is employed, including block chain and secure file transfer tools. Validation and authentication are used to handle all difficulties relating to the exchange of private clinical data. Block chain technology consolidates encryption methods, P2P networks, and distributed storage [3] [4].To access the data on the system, the doctor or hospital must obtain an authorised certificate. Digital certificates can be used by qualified doctors and hospitals [5]. Images and text data are encrypted using a variety of methods. For pictures, the Paillier Cryptosystem algorithm is employed.AES (Advanced Encryption Standard) is used to encrypt text data, and decryption is done using a private key that is only given to doctors and hospitals [6][7].

Proposed System

The system can be accessed by Four types of users: admin, user, pharmacy and doctor.

- To access the programme and modules, the Admin must sign in with valid login credentials.
- After a doctor has registered with the system, the administrator enters their information into the database.
- A Doctor can log in and make changes to his or her personal information.
- A doctor has the ability to view and manage crises, appointments, and patient information.
- To schedule an appointment, the patient must first register with the system.
- In the event of an emergency, the app recognises the patient's position and displays the nearest doctor in an ordered list format, sorted by distance and availability, so that an emergency appointment can be scheduled.
- For an emergency visit, the patient simply needs to submit basic information.
- The patient can enrol in the app and log in to access and edit their information, allowing the doctor to diagnose more quickly.
- The programme dashboards allow the user to see a list of nearby specialised doctors, hospitals, pharmacies, and ambulance services.

Future Scope

More features and functions will be introduced to Life Care in the future, transforming the app into the most successful specialised doctor search.

- Video-calling a doctor via the app
- Rating and comments on doctors
- Incorporate the app with blood banks as well.
- Integrating new data into the existing database, making the app a one-stop shop for finding a doctor online.

CONCLUSION

The medical industry has been progressing in order to provide more modern and efficient health care services. The health-care industry, like other industries, should be digitised. An application is being created that will allow the general public to keep and retrieve their own medical information at any time and from anywhere. The system is made up of specialised doctors who are registered with enrolled hospitals. During the appointment, the doctors provide medical care and prescribe drugs. Our solution connects patients and doctors through virtual dialogue. The GPS-based medical emergency services feature will assist the user in locating the nearest doctor. LIFE CARE acts as an ambulance, a hospital, and a specialised doctor for patients, enhancing medical emergency services.

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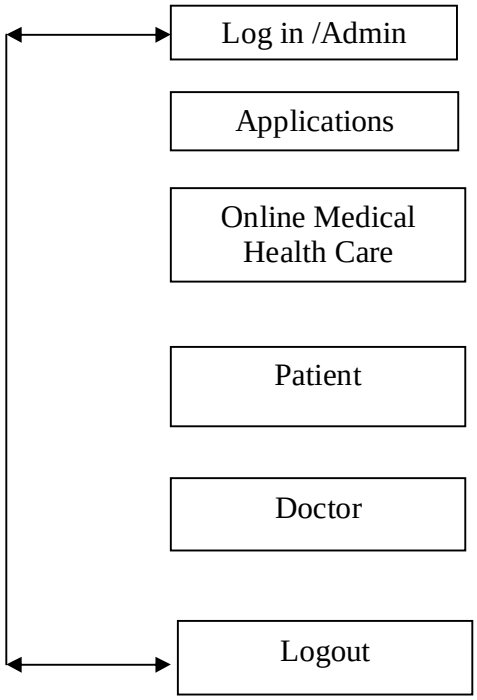

Fig.1.Basic Flowchart

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RESEARCH ARTICLE

Application of Linear Programming in Agriculture

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ABSTRACT

The low productivity of agriculture operations from small and medium farm producers was recognised by the Indian government. This study's conceptual review is based on secondary data, and it applies linear programming to emphasise the influence of agriculture resource allocation decisions on the performance of India's small farmers. . Farm profitability under the existing farmland allocation is likewise considerably lower than the anticipated profit level that might be reached by reallocating cropland using linear programming. These studies advise farmers to improve their agriculture operations in a lucrative way by using linear programming in crop production, as well as to ensure the long-term viability of their crop-forming activities by supporting them under adverse environmental circumstances.

Keywords: Agriculture, Linear Application and Productivity.

INTRODUCTION

Indian formers most of them adopted traditional method of agriculture, this method supporting to the more expenditure and low productivity. The formers are suffering lack of environmental resources, high risk and low profitability. Productivity means generating the maximum output generation from optimal resources of operations. Productivity improvement stimulates researchers to search for methods that can achieve the increase in the productivity which in turn supports business main objectives. Today some of the formers are adopted modern methods and improving the some more productive results comparing to earlier agriculture results or benefits. The agriculture operations management required to the Different techniques for more profitable operations. The linear programming application in agriculture sector more helpful to the formers to improving the productivity, through below Ways when cost is constant,

- If the quantity of input and price is constant, then its helpful to minimizing the cost.
- The crop rotation plan helpful to profit maximization with optimal rotation.

- Mixing of the Chemical or fertilizers applications helpful to the optimization.

The Linear program Mathematical application is helpful to the optimal utilizations of agriculture resources and maximum agricultural output, the high productivity of the agriculture operations more helpful to individual as well as nation also. Linear program applications have the following assumptions.

Proportionality: It means that the contribution of individual variable in the objective function is some proportional to their value. If we change the individual or group Variable value the contribution value also similarly changes accrued in contribution but contribution of every variable unit is constant and its effect of a decision variable in any one equation is proportional to a constant quantity. The framers given input variables are same for every additional variable usage.

Additivity: It is a second assumption of the Linear programming, it means that the total value of objective function and every constraints function is obtained by adding up or subtracted together (but never Multiplied or divided by each other) the every individual contribution from each variable. The linearity is that the all variables are assumed to be mutually independent, It cannot be assumed to hold and Multiplied or divided by one variable to other variables.

The divisibility: Is a third assumption of the linear programming, it means the decision can take on fractional values or real numerical values. In this assumption the variables can take with fractional values. if the former or other production going on continuously, the divisibility is not a problem because the fraction value is considered as a next production period, so divisibility is not a serious concern in linear programming applications.

Certainty: It means that the parameter value in the linear model are known with certainty. The short term problems, the level of probability trends to optimal solution obtained from optimal for the specific problem formulated. Then long term problem usually have improbability standards of linear programming such as decision making and analysis.

METHODOLOGY

Still majority of the people are suffering from their livelihood and employment, because they are engaging activities in agriculture, specifically in rural areas. In this study is based on secondary data, collected from International journals, national journals, websites and blogs. The researcher main objective is to improve the productivity of the formers with application on linear programming model. There is a need for shifting to the profitable operations in forming.

Objectives of the Study

This study focusing on the Linear mathematical application on agriculture operations for sustainability of small and medium formers.

- To know the linear programming Applications are supporting to the agriculture operations.
- To understand the linear applications are suitable to agriculture optimizations.

Review of Literature

The linear programming application is used for optimization method on decision making in various resources allocation problems like land usages. The linier programming based land usage modeling as farm decision tool to increase the efficiency of small and medium formers productions, it enhancing to improving resources use efficiency and enhancing profitability to reducing the operational cost (Chen 1995 and Walangitan 2012). India is a one of the developing economic country in the world. The agriculture contribution is declining year by year while comparing to 1950's to today. The small agriculture formers contributed positive result of the country's GDP up to 1980; later this contribution has been declined (Mellaku,2018). The researchers using many quantitative tools are using the optimal solutions and decision making, in mathematics linear programming is very useful to the formers to

allocation of research and generation of more productivity. The linear programming more helpful to the formers to allocation of the agriculture land, land suitability, potential yield, climate and practices to enhance agriculture production enforcement, it means maximization of profit with high productivity (Minh, 2007). Some research studies done in optimization of agriculture resources usages for better outputs in India, the linear programming is a tool to formers for planning and optimization of agriculture resources allocations (water, land and labor) in production. This tool helpful to maximization of cropping net return on annually with optimal usage of resources like water, land cropping pattern based on monsoon (Junior 2008 and Nath 2002). The researcher applied linear programming technique was applied to determine optimum land for 10 crops with respects to various factors like cost of seeds, cost of fertilizers, labor, machinery usage charges and pesticides. Find the linear programming is the good for finding the optimal land allocations to the major cropping patters for maximizing output (Wankhade 2012, kaur 2010 and jain 2017).

CONCLUSION AND RECOMMENDATIONS

The formers in the small and medium formers categories should raise the portfolio of their operations, the improvement of portfolio results productivity helpful to agriculture sustainable and improving their income of the families. The application analysis favored to formers, portfolio strategy cropping practices, the small scale formers using the optimum combination of resources and high yield crops for maximization of productivity.

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RESEARCH ARTICLE

Renewable Energy Distributed Electricity Generation's Impact on the Environment

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ABSTRACT

A single-stage three-phase four wire grid-connected photovoltaic (PV) system with a dual compensating technique and feed-forward control loop is proposed in this work (FFCL).The PV system serves as a unified power quality conditioner (UPQC), reducing load harmonic currents and compensating reactive power, in addition to injecting active power into the grid. The load is also provided with regulated, balanced, and harmonic-free output voltages. The series converter acts as a sinusoidal current source, while the parallel converter operates as a sinusoidal voltage source, thanks to the PV-dual UPQC's correction method. Without load voltage transients, a seamless shift from interconnected to islanding operation modes, and vice versa, can be achieved. Furthermore, because the FFCL acts on the creation of the series inverter current references, a quick power balance combining the PV array and the grid is created to solve problems associated with sudden solar irradiation changes. As a result, both inverter currents and dc-bus voltage have superior dynamic responses. The active power flow through the inverters is analysed in detail, providing for a thorough understanding of the PV-UPQC operation. The experimental findings of the PV-UPQC connected to the electrical distribution system are presented to evaluate both dynamic and static performance.

INTRODUCTION

Multilevel inverters (MLIs) are becoming more used in businesses as a medium voltage and high-power electronic power conversion solution. The output waveform of a multilevel inverter is improved, and the harmonic content, the

size of the filter utilised, and the degree of electromagnetic interference (EMI) caused by switching operation are all reduced. For higher-power applications, multilevel inverters have numerous advantages. These include the ability to synthesise voltage waveforms with lower harmonic content than two level converters, as well as the ability to operate at higher DC voltages using series coupled semiconductor switches. An inverter's desired output is a sinusoidal waveform that is a constant function of time. When power switches are used to build a static inverter, the output waveform is made up of discrete values. In other words, instead of smooth transitions (dv/dt), the waveform features quick transitions (dv/dt). Two (or three) level inverters use pulse-width modulation (PWM) operation with a high switching frequency to resemble a sinusoidal waveform, with the fundamental component of the output being sinusoidal. This also eliminates the harmonics of lower order. Apart from significant switching losses due to high switching frequency, the lack of high voltage/high power semiconductor switching devices limits the viability of conventional two-level inverters for high-power high or medium-voltage applications. The majority of MLI modulation techniques are based on multiple-carrier arrangements with pulse width modulation (PWM). Vertical shifts (phase disposition, phase opposition disposition, and alternative phase opposition disposition (APOD) PWM) or horizontal displacements (phase-shifted carrier (PSC) PWM) can be used to organise the carriers. The MLI operation uses space-vector modulation (SVM), which has good harmonic performance.

Literature Survey

Pengwei Sun introduced a novel form of cascade inverter based on dual buck inverters with phase-shift control. The proposed cascaded dual buck inverter with phase shift control inherits all of the advantages of dual buck inverters while also overcoming some of their disadvantages (e.g., increased system reliability). By increasing the equivalent switching frequency, the phase-shift control and cascade architecture lower the ripple current or reduce the size of the passive components. The main disadvantage of this inverter is that we must turn on the switches dependent on the direction of the output current, even though cascade topology solves the issue of zero crossing distortion by employing phase shift control technique. Furthermore, current zero-crossing distortion is theoretically avoided when phase shifted PWM is delivered to various cascade units. Himanshu Misra discussed how multilevel voltage source inverters might create high output voltages with low harmonics without the usage of transformers or series-connected synchronised switching devices. To produce 11 level output voltage, the inverter comprises of eleven switches and five different dc sources with a load. In comparison to traditional methods, this method uses a less number of switches. The pulse width modulation approach is used to simulate an eleven-level multilevel inverter. The switches in the upper leg of the circuit have a higher voltage rating than the switches in the lower leg, and the upper two batteries of the circuit are utilised more frequently than the other three batteries in this topology.

Proposed System

The project is implemented in both hardware and simulation using the following two techniques: • Bye-pass diode technique • Common H-Bridge configuration to build a hybrid multilevel inverter, the suggested topology includes a bye-pass diode approach and a common H-Bridge structure. To achieve equivalent voltage steps in the output voltage, an asymmetric voltage source is used. Through a particular circuit, DC sources are connected in series with power switches, and diodes are connected in parallel with the source. The bye-pass diode approach is used to produce only positive voltage steps. A power switch and a diode should be added to the bye-pass diode circuit to enhance the number of levels in the output a source. To produce one complete set of quasi-sine waveforms, the H-bridge circuit converts both positive and negative voltages into positive and negative voltages in the output. During the functioning of the H-bridge, the identical leg switches will not conduct at the same time; instead, one switch from the upper leg and the other switch from the lower leg will conduct. Furthermore, for any number of voltage levels, only one H-bridge circuit is required.

The Inverter's Switching Sequence: The following table shows the switching order for each switch in the proposed hybrid multilevel inverter. The zero level is present in both positive and negative cycles, i.e. the zero state occurs twice in a single cycle. Switches are operated from I to XV (output voltage zero to peak voltage value) to obtain

positive half cycle, and then from XV to I (peak voltage value to zero voltage) to obtain negative half cycle. The inverter's power switch is an IGBT in this case.

Inverter Prototype: A prototype of a hybrid multilevel inverter circuit is created and tested to validate the proposed inverter. Figure 4 depicts the prototype. In the multimeter, the suggested inverter output voltage value is shown. The voltage from peak to peak is approximately 71.8V.With the use of CRO, the 31-level output voltage steps are displayed in Fig 4

CONCLUSION

Multilevel inverters provide better output waveforms and reduced THD than single-level inverters. This project introduces a new hybrid multilevel inverter topology with fewer switches. In the traditional H-bridge multilevel inverter design, a bypass diode approach is used to reduce the number of regulated switches in the system. For the single-phase system, only one H-bridge is required, along with a switch and a diode for each voltage source. Harmonics, switching losses, cost, and overall harmonics distortion all increase when a large number of switches are used in the traditional approach. With fewer switches, this proposed design raises the output voltage level. It significantly reduces the number of switches for a large number of levels, which reduces switching losses, cost, and low order harmonics, substantially improving total harmonics distortion reduction.

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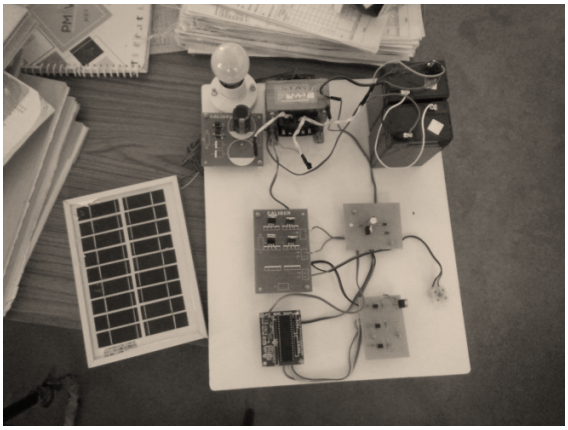
The Inverter's Switching Sequence

S.NO	INTERVALS	ON SWITCHES	CURRENT FLOW	VOLTAGE LEVELS
1	I	S_1	$S_1D_4D_3D_2$	+1Vs
2	II	S_2	$S_2D_1D_4D_3$	+2Vs
3	III	S_1S_2	$S_1S_2D_4D_3$	+3Vs
4	IV	S_3	$S_3D_1D_2D_4$	+4Vs
5	V	S_1S_3	$S_1D_4S_3D_2$	+5Vs
6	VI	S_2S_3	$S_3S_2D_1D_4$	+6Vs
7	VII	$S_1S_2S_3$	$S_1S_2S_3D_4$	+7Vs
8	VIII	S_4	$S_4D_3D_2D_1$	+8Vs
9	IX	S_1S_4	$S_4D_3D_2S_1$	+9Vs

10	X	S_2S_4	$S_4D_3S_2D_1$	+10Vs
11	XI	$S_1S_2S_4$	$S_4D_3S_2S_1$	+11Vs
12	XII	S_3S_4	$S_4S_3D_2D_1$	+12Vs
13	XIII	$S_1S_3S_4$	$S_3D_2D_1D_4$	+13Vs
14	XIV	$S_2S_3S_4$	$S_4S_3S_2D_1$	+14Vs
15	XV	$S_1S_2S_3S_4$	$S_1S_2S_3S_4$	+15Vs
16	XVI	NIL	NIL	0



Inverter Prototype

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RESEARCH ARTICLE

Study of Prescription Pattern of Antiepileptic Drugs in Pregnant Women in a Tertiary Care Hospital

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ABSTRACT

Pregnant women with epilepsy are at increased risk of complications during pregnancy or delivery. Hospital-based studies may provide important information regarding current management and outcomes in these patients. A multitude of prescribing pattern monitoring studies done on different classes of drugs were collected and analyzed. Prescribing pattern monitoring studies using WHO prescribing indicators were also included. This study aimed to determine the prescribing pattern of antiepileptic drugs among pregnant women with epilepsy. Comorbidity is associated with worse health outcomes, more complex clinical management, and increased health care costs. Data were collected for seizure frequency before and during the pregnancy, concurrent medications, pregnancy complications, and neonatal outcomes. We reviewed records of patients with a total of 115 different pregnancies. All patients were treated with antiepileptic medications during their pregnancies, with mono-therapy and poly-therapy. Anti-epileptic drug exposure during pregnancy in mono-therapy 55 cases, poly-therapy 25 cases, and before pregnancy 35 cases. Several older AEDS produce pharmacokinetic interactions via their influence on the hepatic cytochrome P450 and other enzyme systems, affecting the clearance of other AEDS and co-medications. A contraindication is a specific situation in which a drug, procedure, or surgery should not be harmful to the person. Pregnancy complications were anemia, gestational diabetes mellitus, gestational hypertension, intrauterine growth retardation, premature rupture of membrane, and vaginal bleeding. This underscores the need for planned pregnancies so that antiepileptic medications can be optimized prior to pregnancy.

Keywords: Drug-Interaction; Contraindication; Pregnancy; Women with epilepsy; Anti-epileptic drugs; Seizure frequency.

INTRODUCTION

Prescription pattern monitoring studies (PPMS) are drug utilization studies with the main focus on prescribing, dispensing, and administering drugs. They promote appropriate use of monitored drugs and reduction of abuse or misuse of monitored drugs. PPMS also guides and supports prescribers, dispensers, and the general public on the appropriate use of drugs, collaborate, and develop a working relationship with other key organizations to achieve a rational use of drugs [1–6]. Drug Interactions involve combinations of medication with other substances that alter the medication's effect on the body. This can cause the medication to be less or more potent than intended or result in unexpected side effects [7]. A drug interaction occurs when a patient's response to a drug is modified by food, nutritional supplements, formulation excipients, environmental factors, other drugs, or diseases. Interactions between drugs (drug-drug interaction) may be beneficial or harmful. A contraindication is a specific situation in which a drug, procedure, or surgery should not be harmful to the person. There are two types of contraindications, namely reative contraindication and absolute contraindication. Relative contraindication means that caution should be used when two drugs are used together. Absolute contraindication means that event or substance could cause a life-threatening situation[8].

Comorbidity is associated with worse health outcomes, more complex clinical management, and increased health care costs. There is no agreement, however, on the meaning of the term, and related constructs, such as multimorbidity, morbidity burden, and patient complexity, are not well conceptualized[9]. Epilepsy is a CNS problem in which brain activity becomes unusual, causing seizures or periods of abnormal behavior, sensations, and sometimes loss of perception. Anyone can develop epilepsy. Epilepsy affects men, women, and children of all races, ethnic backgrounds, and ages. Seizure symptoms can vary widely[10]. Several people with epilepsy simply observe blankly for some seconds during a seizure, while others persistently shiver their arms or legs. Having one seizure does not mean the person got epilepsy[11]. At least two light seizures are generally required for an epilepsy diagnosis. Treatment with medications or sometimes surgery can control seizures for the bulk of individuals with epilepsy. Some people require lifelong treatment to manage seizures, except for others, the seizures eventually depart. Some children with seizures may outgrow the condition with age[12].

METHODOLOGY

The retrospective study was carried out in the triage area of a tertiary care hospital [13]for a period of 6 months from October 2020 to March 2021 with a sample size of 115 patients. The patients were selected based on the inclusion criteria (Patients with epilepsy, Patients of age group 20-50 of gynecology department) and exclusion criteria (Brainstem stroke, history of peroneal nerve injury). All the referred patients were screened for an anti-epileptic prescription. Data extraction form was used to capture the following information from either the patient or his or her attendant: (a) a brief description/referral note of the current illness, (b) presenting complaints, (c) investigations done previously, (d) interventions done previously, and (e) name of the city/hospital of referring facility/doctor[14,15]. We further analyzed the source of information for pertinent details such as anti-epileptic dosage, frequency, and duration of anti-epileptic use[16]. Data were summarized using descriptive statistics as appropriate.

RESULTS AND DISCUSSION

The study shows that the anti-epileptic drug most prescribed was Carbamazepine (CBZ) and Phenytoin (PHT). In India, except for phenobarbitone, an identical pattern of older AED use has been reported[17]. The use of Valproicacid (VPA) has been related to an increased risk of malformation compared to the use of CBZ, PHT, or Lamotrigine (LTG). VPA continues to be commonly prescribed among our patients and it might be interesting to appear at the trend in prescribing in such patients within the future in response to current awareness of the effects of VPA[18]. Increased seizure frequency occurred in additional than half pregnancies in our patients. Reported rates of patients with changes in seizure frequency during pregnancy are quite variable, probably because of sample size and

methodological differences[19]. Factors that are suggested to influence changes in seizure during pregnancy in a separate patient include altered disposition of AEDs, poor compliance with treatment, psychological stressors, and physiological and hormonal changes[20]. Postpartum bleeding could be a common reason for maternal mortality and anemia has been identified together of possibility factors[21]. AED use during pregnancy has been related to an increased tendency for postpartum bleeding; and thus, anemia must be monitored and treated adequately during pregnancy[18]. The age-wise distribution was created for the ladies with completely different age groups like 20-30, 31-40, and 41-50, which includes the number of cases 40, 60, and 15 the total percentage involved 34.78%, 52.17%, 13.04%. The number of ladies in every age group and their percentage shown below, which shows most of the women belongs to the age group of 31-40 years (52.17%) and very low percentage (13.04%) of ladies belonged to the age groups of 41-50.

Out of 115 cases collected during the study period and the cases were distributed on the basis of obesity. About 80 (69.6%)of the women belong to non-obese and only 35 (30.4%) belong to obese. The cohort of pregnant epileptic women included 115 women exposed to AED in the certain months before pregnancy. The majority of these women 55 (47.8%) received AED mono-therapy during pregnancy; 25 (21.7%) received poly-therapy during pregnancy, and 35 (30.4%) were not exposed to AED at any time during gestation. In monotherapy CBZ (20 cases) was the most commonly prescribed during the preganancy, followed by LTZ (10 cases). The other drugs VPA, Topiramate (TPM), Levetiracetam (LEV), clonazepam and clobazam are prescribed for 5 times each. The details were shown in Table 1.In polytherapy CBZ and VPA is the most commonly prescribed drug combination. 9 out of 25 cases were prescribed with CBZ+VPA combination followed by 5 cases with CBZ+LTG combination. CBZ+TPM and LTG+PHT were prescribed with each 2 cases. Remaining all combinations were given for each one case and the details are shown in Table 2. GBP – Gabapentin (GBP) and Lacosamide (LCM) were also prescribed in the polytherapy.

The study population was distributed on the basis of comorbidities present in the epilepsy women with anxiety and depression most affected and followed by preeclampsia. Most of the patients having multiple co-morbid conditions. The details of comorbid conditions were shown in Table No. 3. The distribution was based on the drug to drug interaction. The prescribed AED drugs and their number of interactions were shown in Table No. 4. The present study was aimed to report the anti-epileptic prescription pattern for the patients referred from various healthcare centers to a tertiary care hospital setup[22]. Patients come to our emergency department from a number of healthcare environments, including stand-alone clinics, private nursing homes, and hospitals, as well as primary and secondary public health facilities and hospitals[23]. Prescription patterns, drug interactions, and contraindications to conventional epileptic drugs, as well as the use of such agents in the presence of such contraindications, were all investigated in this retrospective study. Patients with seizure often have several comorbid conditions; patients with seizure frequently have multiple, often severe contraindications to the medicines available for epilepsy management; and many patients with seizure are given medications despite contraindications to the agents in question[24].

In older adults, non-adherence to treatment is a common issue. Non-adherence has been linked to drug-drug interactions and adverse drug reactions during hospitalization, which is often common in older adults who have been discharged from the hospital and are taking several medications for their chronic diseases. Studies on readmissions due to DDIs and the resulting ADRs were also conducted. As a result, monitoring the occurrence of DDIs and ADRs in the continuum of health care requires early identification and awareness of clinically relevant experiences by healthcare professionals [25]. As a result of this research, the unreasonable anti-epileptic prescribing patterns in referral settings have been identified (both public and private). Anti-epileptic guidelines for the empirical treatment of patients in emergency rooms will be developed using this knowledge. Furthermore, intervention targets in referring healthcare settings such as education about making effective empiric anti-epileptic choices, de-escalation, sending culture culture, and writing specifics of treatment given can be evaluated further in the future [26].

The risk of maternal harm from seizure control loss or drug overdosage can be reduced if anticonvulsant drug dosages in pregnant women with epilepsy are adjusted carefully and at frequent enough intervals during pregnancy

and thus the postnatal weeks, the adjustments being guided where possible by plasma antiepileptic drug concentration monitoring, so long as the pregnant woman compliant. If seizure control is achieved, or as close to it as possible, before pregnancy begins, the corresponding management would most likely be more convenient. Such judicious application of current, primarily pharmacokinetic, expertise may have had a significant positive impact on anticonvulsant drug therapy safety in terms of convulsion control throughout pregnancy. It may seem obvious to say that valproate should not be used in women who are capable of being pregnant. This advice may also be reasonable in relevant focal epilepsies, where there are many alternative antiepileptic agents of more or less equivalent effectiveness and significantly greater protection from the standpoint of foetal defects, as well as likely from the standpoint of the foetus' and infant's logical and behavioural growth.

CONCLUSION

Mono-therapy is usually preferred over poly-therapy whenever possible in epilepsy care. However, a substantial number of patients with intractable epilepsy may respond to AED poly-therapy. Appropriate uses of more than one AED include transitional poly-therapy during conversion to a new mono-therapy and chronic maintenance poly-therapy in refractory patients. When a patient becomes seizure-free while receiving poly-therapy, it may be possible to taper and gradually discontinue the baseline AED which has been previously ineffective or poorly tolerated. Obstinate epilepsy patients should be continuously amended; poly-therapy should be maintained only improved efficacy offset adverse effects. Eliminating unnecessary poly-therapy benefits many patients by reducing adverse effects, and drug interactions.

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Table No 1: Most commonly prescribed AED's as monotherapy during pregnancy and their preganancy categories

S. No	Name of the Drug	Pregnancy Category	Number of Cases
1	Carbamazepine	D	20
2	Lamotrigine	C	10
3	Valproic acid	D	5
4	Topiramate	D	5
5	Levetiracetam	B	5
6	Clonazepam	D	5
7	Clobazem	C	5

Table No 2: Most commonly prescribed AED's as polytherapy during pregnancy and their preganancy categories

S. No	Drugs	Number of cases
1	CBZ + VPA	9
2	CBZ + LTG	5
3	CBZ + TPM	2
4	LTG + PHT	2
5	LTG + VPA	1
6	LTG + LCM	1
7	CBZ + LCM	1
8	LCM + PHT	1
9	LEV + LCM	1
10	LCM + TPM	1
11	LCM + GBP	1

Table No 3: Comorbid conditions of pregnancy patients with AED therapy

S. No	Comorbid Condition	No. of Cases	% of Total
1	Anxiety	55	47.8%
2	Depression	45	39.1%
3	Preclampsia	30	26.1%
4	Euphoria	25	21.7%
5	Hemorrhage	40	34.8%
6	Fatal Growth Restriction	10	08.7%
7	Still Birth	15	13.0%
8	Maternal Mortality	20	17.4%

Table No 4: Drug-Drug interactions of AED drugs

S.No	AED's	Interacting Drug	Effect	No. of Interactions
1	Lamotrigine	Carbamazepine, phenytoin,valproate	Induce glucuronidation	8
2	Carbamazepine	Valporic acid	Enhance their metabolism of carbamazepine	9
3	Topiramate	Carbamazepine	Affects the topiramate level in plasma	2

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RESEARCH ARTICLE

Wireless Sensor Network Based Smart Home for Elderly Care

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ABSTRACT

In this method, a wireless communication system for remote patient monitoring is devised and constructed. The main purpose of this system is to monitor the temperature, heart rate, and pressure of a person's body and present the information to them via IoT. This module is now in charge of human monitoring of almost every Internet of Things topic. The data will be communicated to the controller via a wireless sensor network, and the security monitoring and management system will be in charge of receiving the data transmitted from the controller. This solution uses IoT to deliver a centralised heart rate monitoring system as well as an automatic message alarm system.

Keywords: IoT, networking, wireless communication, human monitoring.

INTRODUCTION

SYSTEM OF HEALTH CARE

Globally, life expectancy has risen as a result of considerable advancements in healthcare and medicine, as well as a growing awareness of personal and environmental hygiene. Furthermore, throughout the last few decades, there has been an increase in interest in family planning, which has contributed to lower birth rates around the world. The World Health Organization (WHO) claims that (WHO). However, in terms of social welfare and healthcare demands, this massive ageing population would have a tremendous impact on society's socio-economic structure. Aside from that, the cost of health-care services continues to rise as the cost of prescription drugs, medical tools, and

hospital care rises. As a result, developing and implementing new strategies and technologies to provide better health care services at an affordable price to the ageing population or people in areas with limited access to healthcare, as well as ensuring maximum comfort, independence, and participation among the people, is critical. People can stay at home instead of going to expensive healthcare facilities like hospitals or nursing homes with remote healthcare monitoring. As a result, it is a more efficient and cost-effective option than on-site clinical monitoring.

Such systems, which are integrated with non-invasive and inconspicuous wearable sensors, can be useful diagnostic tools for healthcare professionals, allowing them to monitor crucial physiological indications and activities of patients in real time from a remote location. Wearable sensors have gained popularity in recent years, and a few devices are now commercially available for individual human services, tens, and movement mindfulness. Ebb and flow devices are not only used in the speciality recreational tens sector, but analysts have also examined its usage in clinical applications. Long-term recording, administration, and clinical access to a patient's physiological data are all possible with remote health monitoring systems. In view of current technological trends, one might easily foresee a moment in the not-too-distant future when your routine physical examination is replaced by a two–three day period of continuous physiological monitoring using appropriate wearable sensors.

During this time, the sensors would continue to gather signals related to your key physiological characteristics and transmit the data to a database linked to your health records. When you go in for your physical, the expert will have both the standard center/lab test-based static assessments of your physiological and metabolic condition, as well as the much more detailed longitudinal record provided by the sensors. The specialist can improve a much better guess for your wellbeing and prescribe treatment, early intervention, and way of life decisions that are especially viable in improving the nature of your wellbeing, using the available information and assisted by decision support frameworks that also approach an expansive corpus of perception information for different people.

Such a difficult breakthrough could have a disruptive impact on global medical service frameworks, lowering human service costs and improving analysis speed and precision. The vision presented in the previous part has been feasible for a few of years. Wearable sensors, on the other hand, have had minimal impact on current clinical practise in terms of medication up to this time. In this paper, we focus specifically on the clinical field, looking at the opportunities provided by current and upcoming breakthroughs, as well as the challenges that must be addressed in order to include these into the act of solution.

OBJECTIVES

Research various user- and device-oriented IDM systems and frameworks in heterogeneous IOT scenarios to obtain a reference state-of-the-art (SOA) status of the technology; identify potential requirements from user and system perspectives to improve the SOA in terms of IDM; and define a specific user scenario for IDM framework implementation. Design a novel user-centered IDM system for use in an IoT scenario that supports complex communication. Define communication relationships in the proposed IDM. Propose a novel identification algorithm for automated user identification. Evaluate and analyse the system's technical and business aspects.

REVIEW OF THE LITERATURE

“Comparative performance analysis between and XBEE ZB module based wireless AD-HOC networks,” Himadri Nath Saha, 2017.XBee modules are embedded solutions that provide wireless communication standard with self-healing mesh networks, which has a longer range than Bluetooth and lower power consumption than Wi-Fi. NRF24L01+ radio modules, which are cheap and powerful, highly integrated, ultra-low power (ULP) 2Mbps RF transceiver ICs for the 2.4GHz ISM (Industrial, Scientific, and Medical) band, are an alternative to XBee radio modules. In this study, the performance of nRF24L01+ modules in wireless ad-hoc networks is examined and compared to that of XBee ZB modules. The analytical study's performance measures are throughput measurement,

mesh routing recovery time, and power consumption. This work has been centred on the developer's open source library, tmrh20, which constructs a complete TCP/IP suite on top of the nRF24L01+ modules' wireless ad-hoc network is a collection of nodes that connect ad hoc without the use of a centralised or permanent infrastructure. Surveillance, widespread environmental sampling, security, and health monitoring are all done through wireless ad-hoc sensor networks. They're especially useful in situations where infrastructure-based networks can't be easily established owing to environmental constraints, such as geography, or where pre-existing network infrastructure can't be quickly deployed, especially if the nodes are movable. The most common technologies for ad-hoc network solutions are Zigbee and Bluetooth. There are many other technologies with limited range that can be used in conjunction with these, particularly in Internet of Things applications. The Zig bee modules are highly sturdy, but they are also quite pricey when compared to other technologies such as Bluetooth and RFID.

PROJECT DESCRIPTION
SOFTWARE DESCRIPTION

The Proteus model is used to explain the proposed system that will be discussed in this phase. The simulation circuit has been constructed in Proteus software using the corresponding components that are present in Proteus in order to produce the desired result. Below is a detailed description of this simulation circuit.

DESCRIPTION OF PROTEUS SOFTWARE

The design and present implementation of the Proteus dependability manager and object factory are described in this chapter.Proteus' current application requirements and the types of Aqua applications it supports are also mentioned. The doorway, which is also a Proteus component.

HOW THE PROTEUS WORKS

Application Model (3.2.1.1)
This section details the types of applications supported by the current Proteus implementation.

Features of Distributed Applications

Aqua applications that use the current Proteus implementation may have the following characteristics:
- Any CORBA object can serve as both a client and a server in the application.
- Any CORBA object in the application can communicate with other CORBA objects in the system.
- State can exist in any CORBA object in the application.

Asynchronous or postponed synchronous communication may be used by the application. Synchronous communication means that when an object sends a request to another object, the request is blocked until the other object responds. In this thesis, postponed synchronous communication is defined as when an object does not block after making a request to another object but retains a request-reply structure. Invocations of hierarchical methods are possible in the application. Consider the following scenario: object A submits a request to object B. Object B may submit a request to object C before responding to object A. It is possible to create an application that is not dependent on the Aqua architecture. Because the programme is developed in such a way that it is unaware that it may be copied, there is very little interaction into Aqua.

It simply takes two more CORBA methods for each object to integrate an application with Proteus. The state of an object can be transferred using these techniques. There are no adjustments to do if an item does not need to be copied. These techniques are used to transmit the state of an object. There are no changes that need to be performed to an item that does not need to be copied.

Requirements for Applications

The requirements for an Aqua application are listed in this section. Each requirement is classified as a design constraint or an implementation constraint. The removal of the limits imposed by the current implementation is discussed in Section 6.2.

PROTEUS's Physical Environment

The Proteus PIC Bundle is a full development, testing, and virtual prototyping solution for embedded system designs based on Microchip Technologies' TM line of microcontrollers. This programme allows you to capture schematics and simulate the circuits you create. During this lab session, you will be given a demonstration on how to use PROTEUS, after which you will be encouraged to learn how to use the software interactively. In the Key words field, type'PIC16F877A'and double-click on the result to add the PIC16F877A to the Object Selector. Replace the LEDs, Buttons, Crystal Oscillator, Capacitors, 7 SEG-COM- Cathode, and Resistors in the same way. Close the Library Browser once you've selected all of the components for the design and left-click once on any component in the Object Selector. Now left-click on the Editing Window to place the component on the schematic; repeat for all other components on the schematic.

THE SYSTEM THAT HAS BEEN PROPOSED

We designed a health monitoring system for older persons living alone in the proposed way to improve lifestyle, improve health care, and promote long-term medical investigations. Wireless Sensor Network research is now being carried out to address medical applications. Temperature sensor devices share data with a distant destination or a monitoring server for diagnostic and monitoring reasons. The Worldwide Positioning System (GPS) is a space-based global navigation satellite system that delivers accurate location and time information in the event of an emergency. The embedded technology based Elder people based human monitoring is an easy approach to identify the differentiation of heart, temperature, and pressure, which is examined by the controller if the biometric limit is exceeded. The message was then conveyed to their concerned doctor via IOT using serial USB connectivity.

CONCLUSION

IOT can combine technology with existing applications or medical support platforms and install large-scale systems in unsupervised environments using this manner. The main goal of this project is to create a heartbeat sensor network that can handle real-time data from various sensors and send it to the computer's MAX 232.Because of these capabilities, this system can be used in hospitals or any other facility that provides healthcare. The data that is sent and received is accurate and in real time. Because of these capabilities, this system can be used in hospitals or any other facility that provides medical and nursing care. Expanding the system to mobile and remote patients, who are connected to a centralised monitoring system and doctors via a wireless body area network, is another enhancement on the study.

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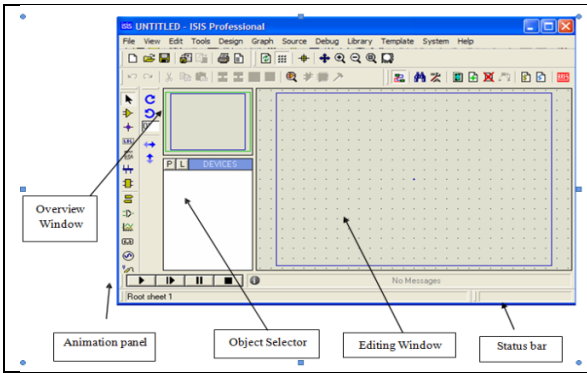

Figure 1. A screen shot of the Proteus IDE

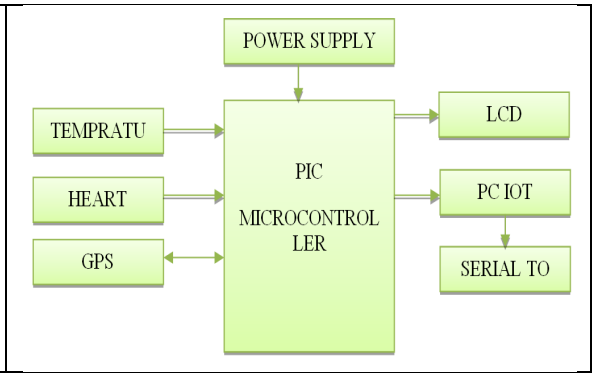

Figure 2. Block Diagram

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RESEARCH ARTICLE

A Study on Volatility of Pharmaceutical Sector in NSE

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ABSTRACT

The stock market is an association of stock purchasers and suppliers representing business proprietorship statements, which can comprise securities listed on the public stock exchange, by way of private-traded stocks, such as private company shares, which are marketed to investors through equity financing platforms. Volatility is an important statistical measure of risk. It can be used to measure the market risk of single instruments. Most of the studies refer to the stock market as a total creation usage of collective evidence figures. The study mainly focuses on the volatility of Pharmaceutical Sectoral Indices and its select companies from the National Stock Exchange. The period of study is from 1st January 2010 to 31st December 2020. The tools used in this study are Unit root test, ARCH and GARCH Model.

Keywords: Stock Market, Returns, ADF Test, Pharmaceutical Sector, Volatility, ARCH and GARCH model.

INTRODUCTION

The Stock Market is the place where companies raise their funds by selling in different types of securities. It gives a vital path to companies for the trading of securities; expand their capital for future expansion of business by selling their share in public with the help of initial public offering. The stock market builds liquidity by prompting investors to sell their securities quickly. This type of activity attracts investors to invest in the stock market in comparison to other sources of funds. By selling and trading their shares, the companies can quickly raise their liquidity in the stock market. Social investment performs dependency on the price of shares. The stock market is an important sector, which boosts faster economic growth and induces the strength in the economy. Volatility is an important statistical measure of risk. Most of the studies refer to the stock market as a whole, making use of aggregate information data. The present study has taken pharmaceuticals Sector companies to analyse the stock market volatility von sectoral

indices of National Stock Exchange. Volatility is not a directly observable variable. In this regard, we can identify two distinct ways used in the literature to define volatility. Kumari and Mahakud (2015) probe the effect of stockholder sentimentality on the obviousness of Indian stock market volatility manipulating the nonlinear conditional mean-variance framework. The provisional volatility is significant for the optimal management of assortment policies. It is important to characterise the variation of conditional volatility in emerging economies like India because it results in optimal portfolio management and risk modelling. To capture the volatility pattern GARCH family of models and VAR-GARCH framework was used. The authors conclude that the negative sentiment has a higher impact on the volatility. Gupta et al. (2016) explained the weak form efficiency of Indian capital market. The four Indices i.e. SENSEX and BSE100 of Bombay Stock Exchange, S&P CNX NIFTY and S&P CNX500 of National Stock Exchange were used in the study to represent the market. The whole period was divided into three parts equally to see the impact of different short periods. The Different statistical tools like Unit Root test, Run test and Kolrilogorov-Smirnovtest (K-S test) were used to analyse the data. The results revealed the present situation of Indian capital market, it was noticed that the Indian stock market did not move in random which has the implication of dependency on past prices. The study proved that the Indian stock market tended not completely adjusting the past information and happenings into present stock prices during the 31 periods of study. It indicated that the market did not move in tandem and it is still not weak-form efficient.AL-Najjar (2016) explains that the stock market volatility has a direct role and influences pricing, risk and portfolio management. This study investigates the volatility patterns in Jordan's capital market concerning volatility clustering, leptokurtosis and leverage effect using symmetric and asymmetric GARCH models like ARCH, GARCH and EGARCH for Amman Stock Exchange (ASE) are used. Findings suggest that the symmetric models capture the volatility clustering and leptokurtic, whereas asymmetric model does not reveal the existence of leverage effect. The nonexistence of leverage effect is because Jordan is an emerging country with limited resources that were affected by political and economic circumstances.

Statement of the Problem

In current periods, the subject of returns and volatility has developed progressively pertinent for Indian investors, regulators, traders, policy makers and researchers with an increase in stock market investment. As a sign of this proposed research, an effort requires to examine returns and volatility. From the investor's point of view, the result of the analysis could be extremely useful in making an investment decision and may be more beneficial. The present study seeks to analyse the relationship and effect of stock market volatility and projected returns on the Indian stock market.

Objectives of the Study

The main objective of the study is to express the performance of the stock value within the Indian Stock market. The objectives of the study are as follows.

To analyse the Stock prices of selected Pharmaceutical companies in Pharmaceutical Sectoral Indices of National Stock Exchange.

To analyse the fluctuations in closing prices in CNX Nifty and selected Pharmaceutical companies in Sectoral Indices of National Stock Exchange.

Hypotheses of the Study

H_{01}: There is no stationarity between the stock prices of selected pharmaceutical companies of Pharmaceutical Sectoral Indices of NSE.

H_{02}: There is no fluctuation between closing prices in CNX Nifty and selected Pharmaceutical companies in Pharmaceutical Sectoral Indies of National Stock Exchange.

Research Methodology

The selection criteria for the sectoral indices include the following:

There are two conspicuous Stock Exchanges Market in India, i.e., Bombay Stock Exchange (BSE) and National Stock Exchange (NSE). The exact reason for selecting the National Stock Exchange is for their trading method and its direct

participation. It introduced the screen-based trading so trading becomes very professional and transparent so that an investor can directly participate in the stock market. Hence the National Stock Exchange is selected for the study. The National Stock Exchange consist of four major categories namely Broad Indices, Sectoral Indices, Thematic Indices and Strategy Indices. From this, Sectoral Indices is taken for the study. The present study depends on Sectoral Indices and selected companies from Pharmaceutical sectoral Indices. The Sectoral Indices from National Stock Exchange, the top ten companies are selected based in Market Capitalization. The study comprises daily closing prices of companies and the closing value of CNX Nifty.

Analysis of the Study

Descriptive Statistics

Table-1 represents the descriptive statistics of the Pharmaceutical sector of National Stock Market for the period of 1st January 2010 to 31st December 2020. Here the table describes CNX NIFTY mean value 0.034 and standard deviation which is 36.83. The standard deviation is implied that there is a greater degree of variability due to high deviation. It means that the mean value is normally distributed. Kurtosis value is Leptokurtic (5.820) because the value is greater than three and it is considered to be risky. The mean distribution of CNX Nifty is positively skewed (0.000) that indicates the distribution towards the right-tailed. JB test results from probability 0.000 for the significant level of 5% and it shows that the data are normally distributed in CNX NIFTY. Hence the null hypothesis (H_0) is rejected. In this period of study of all Pharmaceutical sector companies highest mean is from torrent limited 0.091.

The lowest mean is from Glenmark 0.004. The value of Standard deviation for Aurobindo is 12.90which highly deviates whereas 2.880 is for Cipla which is less deviate. The value of skewness is at 0 levels which are positively skewed for all the Pharmaceutical companies. So the distribution will have a right tail for all pharmaceutical companies. The Kurtosis value is less than 3 it is platykurtic for Aurobindo, Biocon, Cipla, Cadila, Glenmark, Dr Reddy, Sun pharma and torrent it observed that distribution is entirely normally distributed so it helps the investors to experience the great returns. All the p-values are less than (0.05) at 5% level of significance and it shows that there is no normality in closing prices hence the null hypothesis is rejected. Henceforth the investors can safely invest in the companies which are fluctuating moderately to earn more profit during this study period.

Augmented Dickey Fuller Test

Table-2 represents the Augmented Dickey-Fuller unit root test to test the stationarity of sectoral indices with CNX Nifty of National Stock Exchange (NSE) during the period of 1st January 2010 to 31st December 2020. It describes the results of the Unit Root test applied to determine the order of integration among level 1st difference, 2nd difference under the assumption of constant, intercept and trend. The consequence fails to reject the null hypothesis of a unit root in their level form. It implies that there is no possibility of the series to be stationary around a constant Mean of an around deterministic trend. Therefore the first difference of all series is tested for stationary of the series. The results revealed that the Pharmaceutical Sector with CNX NIFTY of National Stock Exchange is not stationary at the level of Integration ***I(0).*** But it becomes Stationary when its first difference was taken. That is, the degree of integration of this series is ***I (1)***. It indicates that the null hypothesis is rejected at 1 % level of significance.

To analyse the fluctuations in closing prices in CNX Nifty and selected companies in Sectoral Indices of National Stock Exchange

ARCH Model

ARCH effect of closing prices in CNX NIFTY & Pharmaceutical Sector that are listed in the National Stock Exchange is exhibited in the above table 3. The results display that the p-value of F-statistics is less than 0.05. Thus the null hypothesis (H_0) that there is no ARCH effect in closing prices of CNX NIFTY & Pharmaceutical Sectoral Indices that are listed in NSE is rejected at 5% level of significance.

Volatility Changes in Garch Effect Model

H_0: There is no GARCH effect between CNX NIFTY & Pharmaceutical Sectoral Indices

The above table -4 reveals the volatility changes in GARCH effect. It describes the fluctuations of closing prices between CNX Nifty and NSE Pharmaceutical Sector. In this analysis, if the value "α +β" is nearer to '1', it means that there is high volatility. If the value is lesser than '1', it will show lower volatility. From this table, closing prices of CNX Nifty and Aurobindo (0.129 + (-0.003) = 0.126) is lesser to 1. So, there is less volatility in NSE Auto. The GARCH p-value is less than 0.05 per cent significant level that implies the last month volatility of CNX NIFTY and Aurobindo influences the last month volatility rates. Hence it rejects null hypotheses. The above table -6 reveals the volatility changes in GARCH effect. It describes the fluctuations of closing prices between CNX Nifty and Biocon. In this analysis, if the value "α +β" is nearer to '1', it means that there is high volatility. If the value is lesser than '1', it will show lower volatility. From this table, closing prices of CNX Nifty and Biocon (0.1295+ (-0.0034) =0.134) is lesser to 1. So, there is less volatility in Biocon. The GARCH p-value is less than 0.05 per cent significant level that implies the last month volatility of CNX NIFTY and Bioconinfluences the daily volatility rates. Hence it rejects null hypotheses.

The above table -6 reveals the volatility changes in GARCH effect. It describes the fluctuations of closing prices between CNX Nifty and Cadila. In this analysis, if the value "α +β" is nearer to '1', it means that there is high volatility. If the value is lesser than '1', it will show lower volatility. From this table, closing prices of CNX Nifty and Cadila (0.128 + (-0.003) = 0.124) is lesser to 1. So, there is less volatility in Bosch. The GARCH p-value is less than 0.05 per cent significant level that implies the last month volatility of CNX NIFTY and Cadila influences the current month volatility rates. Hence it rejects null hypotheses. The above table -7 reveals the volatility changes in GARCH effect. It describes the fluctuations of closing prices between CNX Nifty and Cipla. In this analysis, if the value "α +β" is nearer to '1', it means that there is high volatility. If the value is lesser than '1', it will show lower volatility. From this table, closing prices of CNX Nifty and Cipla(0.294 + (-0.004) = 0.289) is nearer to 1. So, there is high volatility in Cipla. The GARCH p-value is less than 0.05 per cent significant level that implies the last month volatility of CNX NIFTY and Cipla influences the current month volatility rates. Hence it rejects null hypotheses. The above table -8 reveals the volatility changes in GARCH effect. It describes the fluctuations of closing prices between CNX Nifty and Divis Lab. In this analysis, if the value "α +β" is nearer to '1', it means that there is high volatility. If the value is lesser than '1', it will show lower volatility. From this table, closing prices of CNX Nifty and Divis Lab (0.128 + (-0.003) = 0.916) is nearer to 1. So, there is high volatility in the Divis lab. The GARCH p-value is less than 0.05 per cent significant level that implies the last month volatility of CNX NIFTY and Divislab influences the current month volatility rates. Hence it rejects null hypotheses.

The above table -9 reveals the volatility changes in GARCH effect. It describes the fluctuations of closing prices between CNX Nifty and Dr Reddy. In this analysis, if the value "α +β" is nearer to '1', it means that there is high volatility. If the value is lesser than '1', it will show lower volatility. From this table, closing prices of CNX Nifty and Dr.Reddy(0.1320 + (-0.0038) =0.1281) is nearer to 1. So, there is high volatility in Dr Reddy. The GARCH p-value is less than 0.05 per cent significant level that implies the last month volatility of CNX NIFTY and Dr Reddy influences the current month volatility rates. Hence it rejects null hypotheses. The above table -10 reveals the volatility changes in GARCH effect. It describes the fluctuations of closing prices between CNX Nifty and Glenmark. In this analysis, if the value "α +β" is nearer to '1', it means that there is high volatility. If the value is lesser than '1', it will show lower volatility. From this table, closing prices of CNX Nifty and Glenmark (0.1500+ (-0.0027) = 0.1473) is less to 1. So, there is low volatility in Glenmark. The GARCH p-value is less than 0.05 per cent significant level that implies the last month volatility of CNX NIFTY and Glenmark influences the current month volatility rates. Hence it rejects null hypotheses. The above table -11 reveals the volatility changes in GARCH effect. It describes the fluctuations of closing prices between CNX Nifty and Lupin. In this analysis, if the value "α +β" is nearer to '1', it means that there is high volatility. If the value is lesser than '1', it will show lower volatility. From this table, closing prices of CNX Nifty and Lupin (0.13636 + (-0.003852)=0.1324) is nearer to 1. So, there is high volatility in Lupin. The GARCH p-value is less than 0.05 per cent significant level that implies the last month volatility of CNX NIFTY and Lupin influences the current month volatility rates. Hence it rejects null hypotheses.

The above table -12 reveals the volatility changes in GARCH effect. It describes the fluctuations of closing prices between CNX Nifty and Sun Pharma. In this analysis, if the value "α +β" is nearer to '1', it means that there is high volatility. If the value is lesser than '1', it will show lower volatility. From this table, closing prices of CNX Nifty and Sun Pharma (0.1270 + (-0.0052) = 0.1155)) is nearer to 1. So, there is high volatility in Sun Pharma. The GARCH p-value is less than 0.05 per cent significant level that implies the last month volatility of CNX NIFTY and Sun Pharma influences the current month volatility rates. Hence it rejects null hypotheses. The above table -13 reveals the volatility changes in GARCH effect. It describes the fluctuations of closing prices between CNX Nifty and Torrent. In this analysis, if the value "α +β" is nearer to '1', it means that there is high volatility. If the value is lesser than '1', it will show lower volatility. From this table, closing prices of CNX Nifty and Torrent (1.2548 + (-0.0001) = 1.2547) is greater to 1. So, there is high volatility in Torrent. The GARCH p-value is less than 0.05 per cent significant level that implies the last month volatility of CNX NIFTY and Torrent influences the current month volatility rates. Hence it rejects null hypotheses.

FINDINGS AND CONCLUSION

Table-1 represents the descriptive statistics of the Pharmaceutical sector of National Stock Market for the period of 1st January 2010 to 31st December 2020. The standard deviation of CNX Nifty is implied that there is a greater degree of variability due to high deviation. It means that the mean value is normally distributed. The mean distribution of CNX Nifty is positively skewed (0.000) that indicates the distribution towards the right-tailed. JB test results from probability 0.000 for the significant level of 5% and it shows that the data are normally distributed in CNX NIFTY. Hence the null hypothesis (H_0) is rejected. In this period of study of all Pharmaceutical sector, The value of skewness is at 0 levels which are positively skewed for all the Pharmaceutical companies. So the distribution will have a right tail for all pharmaceutical companies. The Kurtosis value is less than 3 it is platykurtic for Aurobindo, Biocon, Cipla, Cadila, Glenmark, Dr Reddy, Sun pharma and torrent it observed that distribution is entirely normally distributed so it helps the investors to experience the great returns. All the p-values are less than (0.05) at 5% level of significance and it shows that there is no normality in closing prices hence the null hypothesis is rejected. Henceforth the investors can safely invest in the companies which are fluctuating moderately to earn more profit during this study period. Table-II results revealed that the Pharmaceutical Sector with CNX NIFTY of National Stock Exchange is not stationary at the level of Integration ***I(0).*** But it becomes Stationary when its first difference was taken. That is, the degree of integration of this series is ***I (1)***. It indicates that the null hypothesis is rejected at 1 % level of significance. Table-III results revealed the ARCH Effect is stationary for CNX Nifty and Select Pharmaceutical companies this test indicates the Hetroscadas city between the variables so it allows proceeding with GARCH Model to find the volatility. GARCH Effect indicates that there is a moderate fluctuation in many companies so investors can invest in the companies which have low fluctuations to earn more returns.

CONCLUSION

The present study would be useful for the investors because it provides empirical evidence on the volatility of the Pharmaceutical sector and its select companies. Before deciding on the investment it is more essential to analyse the volatility of the sectors as well as the companies. They should have a systematic investment plan as it is more efficient to benefit out of the volatility. The markets move up and down over the period by investing through systematic investment plan, one has the opportunity to enter at every stage of the market to earn good returns.

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Table 1: Descriptive statistics for CNX Nifty and Pharmaceutical Sector from 1st January 2010 to 31st December 2020

Variables	Auro bindo	Biocon	Cadila	Cipla	Divis	Glenmark	Lupin	Dr Reddy	Sun Pharm	Torrent	CNXRET
Mean	0.065	0.074	0.042	0.014	0.069	0.009	0.039	0.037	0.042	0.091	0.034
Std. Dev.	12.90	16.93	8.835	2.880	5.015	3.856	4.986	11.91	5.043	5.769	36.83
Skewness	0.489	0.053	0.187	0.767	0.031	0.103	0.55	0.059	0.506	0.277	0.000
Kurtosis	2.353	1.721	1.984	1.175	4.024	1.312	4.282	1.797	2.824	2.822	5.881
JB	554.8	294.3	392.4	134.8	163.8	169.0	185.3	320.5	803.02	801.5.	266.12
Prob	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

(Rupees in crores)

Table 2: Augmented Dickey-Fuller test for CNX Nifty and Pharmaceutical Sector from January 1st 2010 to 31st December 2020

	Level		1st difference	
Variable	**T-stat**	**Probability**	**T-Stat**	**Probability**
CNX Nifty	-25.894	0.000	-20.764	0.000
Aurobindo	-1.239	0.659	-51.177	0.000
Biocon	-0.130	0.944	-50.242	0.000
Cadila	-1.675	0.433	-49.017	0.000
Cipla	-1.915	0.325	-51.568	0.000
Divis	0.124	0.967	-47.793	0.000
Dr Reddy	-2.099	0.244	-44.853	0.000
Glenmark	-1.505	0.531	-47.793	0.000
Lupin	-1.55	0.505	-47.789	0.000
Sun Pharma	-1.802	0.379	-47.491	0.000
Torrent	-0.677	0.850	-37.689	0.000

Table 3: Hetroscadascity test for CNX Nifty and Pharmaceutical Sector from 1st January 2010 to 31st December 2020

			ARCH EFFECT	
Variables	**F-stat**	**Probability-F**	**Observed-R square**	**Probability Chi-Square**
CNX Nifty	185.22	0.0000	172.40	0.0000
Aurobindo	787.73	0.0000	597.39	0.0000
Biocon	791.06	0.0000	599.30	0.0000
Cadila	791.20	0.0000	599.37	0.0000
Cipla	781.63	0.0000	593.88	0.0000
Divis	782.32	0.0000	594.27	0.0000
Dr Reddy	793.10	0.0000	600.46	0.0000
Glenmark	783.98	0.0000	595.23	0.0000
Lupin	784.05	0.0000	595.27	0.0000
Sun Pharma	764.48	0.0000	583.88	0.0000
Torrent	779.57	0.0000	592.63	0.0000

Table 4: Closing Prices of CNX Nifty and Aurobindo Result with GARCH Model

Dependent Variable: CNX Nifty Method: ML-ARCH(Marquardt)-Student's t distribution - GARCH= C(3)+C(4)*RESID(-1)^2 + C(5)*GARCH(-1)				
Variable	**Coefficient**	**Std. Error**	**Z-Statistics**	**Prob.**
C	-0.002	0.014	-0.212	0.031
Variance Equation				
C	19.382	0.925	20.935	0.000
Resid(-1)^2	0.129	0.051	2.505	0.122
GARCH(-1)	-0.003	0.001	-2.464	**0.013**

Source: *Compiled & calculated* **Significant at 5% level*

Table 5: Closing Prices of CNX Nifty and Biocon result with GARCH Model

Dependent Variable: CNX Nifty Method: ML-ARCH(Marquardt)-Student's t distribution - GARCH= C(3)+C(4)*RESID(-1)^2 + C(5)*GARCH(-1)				
Variable	**Coefficient**	**Std. Error**	**Z-Statistics**	**Prob.**
C	-0.002	0.014	-0.212	0.831
Variance Equation				
C	19.382	0.925	20.935	0.000
Resid(-1)^2	0.1295	0.0517	2.5053	0.012
GARCH(-1)	-0.0034	0.0013	-2.4646	**0.013**

Source: *Compiled & calculated* **Significant at 5% level*

Table 6: Closing Prices of CNX Nifty and Cadila Result with GARCH Model

Dependent Variable: CNX Nifty Method: ML-ARCH(Marquardt)-Student's t distribution GARCH= C(3)+C(4)*RESID(-1)^2 + C(5)*GARCH(-1)				
Variable	**Coefficient**	**Std. Error**	**Z-Statistics**	**Prob.**
C	0.002	0.004	0.486	0.626
Variance Equation				
C	22.39	8.290	2.701	0.006
Resid(-1)^2	0.128	0.080	1.601	0.109
GARCH(-1)	-0.003	0.002	-1.755	**0.079**

Source: *Compiled & calculated* **Significant at 5% level*

Table 7: Closing Prices of CNX Nifty and Cipla Result with GARCH Model

Dependent Variable: CNX Nifty Method: ML-ARCH(Marquardt)-Student's t distribution GARCH= C(3)+C(4)*RESID(-1)^2 + C(5)*GARCH(-1)				
Variable	**Coefficient**	**Std. Error**	**Z-Statistics**	**Prob.**
C	0.174	0.001	140.8	0.000
Variance Equation				
C	63.813	0.343	185.72	0.000
Resid(-1)^2	0.294	0.098	2.995	0.002
GARCH(-1)	-0.004	0.001	-2.542	**0.011**

Source: *Compiled & calculated* **Significant at 5% level*

Table 8: Closing Prices of CNX Nifty and Divis Lab Result with GARCH Model

Dependent Variable: CNX Nifty Method: ML-ARCH(Marquardt)-Student's t distribution GARCH= C(3)+C(4)*RESID(-1)^2 + C(5)*GARCH(-1)				
Variable	**Coefficient**	**Std. Error**	**Z-Statistics**	**Prob.**
C	0.0653	0.162	0.401	0.688
Variance Equation				
C	20.387	1.081	18.84	0.000
Resid(-1)^2	0.1284	0.053	2.403	0.016
GARCH(-1)	-0.003	0.001	-2.369	**0.017**

Source: *Compiled & calculated* **Significant at 5% level*

Table 9: Closing Prices of CNX Nifty and Dr Reddy Result with GARCH Model

Dependent Variable: CNX Nifty Method: ML-ARCH(Marquardt)-Student's t distribution GARCH= C(3)+C(4)*RESID(-1)^2 + C(5)*GARCH(-1)				
Variable	**Coefficient**	**Std. Error**	**Z-Statistics**	**Prob.**
C	0.000	0.0677	0.013	0.989
Variance Equation				
C	22.229	0.924	23.91	0.000
Resid(-1)^2	0.1320	0.0484	2.724	0.006
GARCH(-1)	-0.0038	0.0014	-2.659	**0.007**

Source: *Compiled & calculated* **Significant at 5% level*

Table 10: Closing Prices of CNX Nifty and Glenmark Result with GARCH Model

Dependent Variable: CNX Nifty Method: ML-ARCH(Marquardt)-Student's t distribution GARCH= C(3)+C(4)*RESID(-1)^2 + C(5)*GARCH(-1)				
Variable	**Coefficient**	**Std. Error**	**Z-Statistics**	**Prob.**
C	0.0167	0.277	0.0603	0.951
Variance Equation				
C	17.693	0.691	25.576	0.000
Resid(-1)^2	0.1500	0.037	3.9561	0.001
GARCH(-1)	-0.0027	0.000	-3.7633	**0.0002**

Source: *Compiled & calculated* **Significant at 5% level*

Table 11: Closing Prices of CNX Nifty and Lupin Result with GARCH Model

Dependent Variable: CNX Nifty Method: ML-ARCH(Marquardt)-Student's t distribution GARCH= C(3)+C(4)*RESID(-1)^2 + C(5)*GARCH(-1)				
Variable	**Coefficient**	**Std. Error**	**Z-Statistics**	**Prob.**
C	0.4655	0.1079	4.3132	0.000
Variance Equation				
C	22.899	4.2969	5.3292	0.0000
Resid(-1)^2	0.1363	0.0731	1.8636	0.0624
GARCH(-1)	-0.0038	0.0020	-1.8766	**0.0606**

Source: *Compiled & calculated* **Significant at 5% level*

Table 12: Closing Prices of CNX Nifty and Sun Pharma Result with GARCH Model

Dependent Variable: CNX Nifty Method: ML-ARCH(Marquardt)-Student's t distribution GARCH= C(3)+C(4)*RESID(-1)^2 + C(5)*GARCH(-1)				
Variable	**Coefficient**	**Std. Error**	**Z-Statistics**	**Prob.**
C	-0.0077	0.0198	-0.3914	0.6954
Variance Equation				
C	27.579	1.0771	25.603	0.0000
Resid(-1)^2	0.1207	0.0329	3.666	0.000
GARCH(-1)	-0.0052	0.0014	-3.5826	**0.0003**

Source: *Compiled & calculated* **Significant at 5% level*

Table 13: Closing Prices of CNX Nifty and Torrent Result with GARCH Model

Dependent Variable: CNX Nifty Method: ML-ARCH(Marquardt)-Student's t distribution GARCH= C(3)+C(4)*RESID(-1)^2 + C(5)*GARCH(-1)				
Variable	**Coefficient**	**Std. Error**	**Z-Statistics**	**Prob.**
C	0.0503	0.0152	3.3026	0.001
Variance Equation				
C	10.356	15.337	0.6752	0.4995
Resid(-1)^2	1.2548	1.8820	0.6675	0.5049
GARCH(-1)	-0.0001	0.0010	-0.1602	**0.8727**

Source: *Compiled & calculated* **Significant at 5% level*

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RESEARCH ARTICLE

Observation on Self-Suggested Fitness Problems in Elderly People in a Rural Place of East Godavari District Madals, A.P., South India

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ABSTRACT

The purpose of this observation was to learn about senior people's self-reported health concerns and how to teach them about their difficulties in a rural setting. There may be an awareness of elderly health difficulties. A reduction in physical size and health is a common symptom of old age.

Keywords: Elder persons, Rural Area, Unwellness Behavior, Activities of Daily Living, Health Problems.

OBJECTIVE OF RESEARCH

The purpose of this study was to discover the elderly's self-suggested health concerns and their health-seeking behaviour in a rural setting.

MATERIALS AND METHODS

In a rural area of Allavaram and Kajulur Mandal, East Godavari District, Andhra Pradesh, India, a community-based cross-sectional study was conducted among the elderly. Information on socio-demographic factors and self-reported illness was collected using a systematic, pretested interview schedule. Methodology: Between May and June 2020, a community-based cross-sectional survey was undertaken. 700 older people aged 60 and up who were willing to participate were randomly selected using a simple random selection procedure.

In total, 700 senior individuals were served in the area. Almost all of the elderly (97%) said they had one or more infections. Joint discomfort (54.6 percent), vision problems (53.6 percent), diabetes (48.7%), hearing problems (46.4

percent), high blood pressure (45.3 percent), and sleepiness (36 percent) were among the most prevalent symptoms mentioned by the participants. Thirty percent of the elderly are unconcerned about infections. The population is ageing at a considerably higher rate than in the past. Every country faces significant hurdles in ensuring that its health and social systems are prepared to take advantage of this demographic transformation. The proportion of the world's population aged 60 and up will nearly double from 12 percent to 22 percent between 2015 and 2050. Older individuals contribute to their families and communities in a variety of ways. Longer lives provide chances for elderly persons and their families, as well as for societies as a whole. The rate of population ageing is likewise rapidly growing over the world. China and India will have a little more than two decades to make the same adjustments.

People can enjoy these extra years of life if they are in excellent health and live in a supportive environment, however their ability to do the things they value will differ slightly from that of a younger person. If these extra years are dominated by a loss in physical and mental capabilities, the consequences for older persons and society will be more severe.

WHO's point of view

WHO is developing a comprehensive Global Strategy and Action Plan on Ageing and Health in conjunction with Member States and other partners, in compliance with a recent World Health Resolution. Global Strategy and Aging and Health are two areas where WHO is considering taking action. Requires awareness of the value of Healthy Ageing and sustained commitment and action.

1. Health-care systems and providers must be better organised around older people's needs and preferences, as well as geared to increase older people's intrinsic capacity.
2. Long-term care systems are essential in all countries to satisfy the demands of the elderly. To this end, long-term care systems are being developed.
3. Age-friendly environments will necessitate activities in all policies and at all levels of government to oppose ageism, empower autonomy, and encourage Healthy Aging.
4. For a wide spectrum of ageing challenges, focused study, new measures, and analytical approaches are required.

In most cases, old age is followed by a decline in physical health. There is a need to focus on the health concerns of the elderly and their health-seeking behaviour, especially in a nation like India where health-care facilities are not uniformly available or accessible. Economic insecurity, poor physical endurance, social isolation, reduced cognitive ability, reliance, and loneliness all influence their health-seeking behaviour. This renders individuals more susceptible to ailments that may be curable or whose incapacitating consequences can be postponed. Among a rural area in East Godavari, this study aimed to discover self-reported health concerns in the elderly and health seeking behaviour for the stated disorders.

METHODS

A.P. In the rural areas of Allavaram and Kajulur Mandal, East Godavari District, Andhra Pradesh, India, we conducted this community-based cross-sectional study. We enlisted older people (>60 years old) from roughly 700 members using a simple random sampling technique.

DESIGN STUDY

According to the 2011 Census, Allavaram Mandal has a total population of 68,242, with 34,034 males and 34,208 females. Allavaram Mandal's average Sex Ratio is 965. Allavaram Mandal has a literacy rate of 78 percent.

The Kajulur Mandal had a population of 70,903 people according to the 2011 census. There are 35,825 males and 35,078 females in the total population, for a sex ratio of 979 females every 1000 males. With 43,890 literates, the average literacy rate is 69.04 percent.

Data Gathering

The data was acquired from this selected study sample using a pretested personal interview questionnaire with the following parameters: age, sex, mental status, economic dependency, activities of daily living, and addictions, among others.

Analytical Statistics

The data was examined using the Chi-square test with a 95% confidence interval; a p value of less than 0.05 (p0.05) was considered significant, and R Statistical Software was utilised to do so.

RESULTS

Participants' socio-demographic traits include

The study enlisted the participation of 700 people. Table 1 indicates the majority of respondents in the 60-65 (289, 41.29 percent) and 66-70 (193, 27.57 percent) age groups. The average age of the participants in the study was 67 years old, with a standard deviation of 3.5 years. 88 percent of older respondents are illiterate, with primary school, high school, and graduates accounting for the smallest percentages. The majority of members (57%) live with their spouse and children, while 37% live alone with their spouse or children. Because of their rural upbringing, 82 percent of responders fall below the poverty line. These were on the verge of becoming registered in government programmes. Table-I: Distribution of study subjects according to their demographic characteristics

Observation on Fitness Problems elder persons

Nearly all the elderly (97%) suggested one or greater infection. Joint pain (54.6%), visual issues (53.6%), diabetes(48.7%), hearing troubles (46.4%), high blood pressure (45.3%) and sleeplessness (36%) have been the common problems reported by the observe members. 30% of elderly who mentioned any infection did no longer are seeking any care. Less than 5% reported health problems are Depression, Paralysis, Diarrhea and Neurological problems, chi-square test applied these ones.

DISCUSSION

This research was carried out in the rural parts of East Godavari District, Andhra Pradesh, India, in the Mandals of Allavaram and Kajulur. Morbidity among the elderly, as reported by themselves. More than one morbidity was reported by the majority of the elderly. When comparing the self-reported morbidity profile of the elderly in this study to other studies conducted in India, there is some difference. This could be explained by the different classifications utilised in various research, as well as differences in the age distribution of the elderly. The elderly believed that their ailments were not serious and that they were normal for their age. It's probable that a physician's examination would have identified major issues. Random sampling was used to identify study participants, and interviews were done. The research population is limited to a small geographic area. There's a risk that the elderly have underreported their illnesses, and that some of them have forgotten about illnesses that they thought were normal at the time. To estimate the common morbidities in this age range, community-based research should be conducted in various parts of India. The health-care system should establish plans based on the ageing population's "felt requirements."

CONCLUSION

We discovered that the majority of the older people had numerous morbidities. A select group of elderly adults who are physically fit as a result of their healthy living choices have influenced fashion trends and inspired others.

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Table 1. Participants' socio-demographic traits

Characteristic	frequency	%
Age Group		
60-65	289	41.29
66-70	193	27.57
71-75	126	18.00
75<	92	13.14
Education		
Illiterate	458	65.43
Primary	158	22.57
High School and inter	72	10.29
Graduate	12	1.71
Living with		
Only Spouse	155	22.14
Spouse and Children	402	57.43
Only Children	105	15.00
Alone	38	5.43
Below poverty line		
Economically Dependent	576	82.29
Economically Independent	124	17.71
Registered under a government scheme for the elderly		
Yes	637	91
No	63	9

Table 2. Self-Reported Morbidity among Elderly People

Sl.No.	Self-reported morbidity	Male (325)	Female (375)	Total (700)	P value
1	Body ache/joint ache	144 (44.21)	239 (63.6)	382 (54.6)	<0.0001
2	Visual issues	194 (59.83)	181 (48.2)	375 (53.6)	0.003
3	Diabetes	168 (51.58)	173 (46.2)	341 (48.7)	0.164
4	Hearing issues	197 (60.70)	128 (34.0)	325 (46.4)	<0.0001
5	Hypertension	85 (26.03)	233 (62.0)	317 (45.3)	<0.0001
6	Sleeplessness	123 (37.9)	129 (34.3)	252 (36.0)	0.3852
7	Cough that lasts a long time	67 (20.46)	158 (42.0)	224 (32.0)	<0.0001
8	Dental issues	88 (27.15)	94 (25.0)	182 (26.0)	0.6042
9	Headache Appetite/weight loss	65 (19.96)	98 (26.0)	162 (23.2)	0.068
10	Back pain	23 (7.07)	128 (34.0)	151 (21.5)	<0.0001
11	Breathlessness/chest pain	71 (21.87)	68 (18.0)	139 (19.8)	0.2572
12	Urinary issues	18 (5.53)	98 (26.0)	116 (16.5)	<0.0001
13	Pain in the abdomen	56 (17.26)	30 (8.0)	86 (8.3)	<0.0001
14	Constipation	40 (12.22)	18 (4.9)	58 (8.3)	<0.0001

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RESEARCH ARTICLE

Antioxidant Properties of Native and Dual Modified White and Black Rice Flour

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ABSTRACT

Free radicals are highly reactive chemical entities that may damage biomolecules such as DNA, proteins, and membrane lipids, leading to the development of a wide range of chronic illnesses including cardiovascular disease, neurological disorders, cancer, diabetes, and ageing . Antioxidants help to prevent illness by neutralising excess free radicals and shielding cells from the harmful consequences of free radical damage. When compared with polished white rice , black rice is rich in proteins, B-vitamins, minerals and antioxidants especially anthocyanins. Temperature and heating time had a significant impact on total anthocyanin content and total antioxidant activity. In this study, the dual modification techniques applied were enzymatic modification and heat moisture treatment (HMT), with the objective to determine and compare antioxidant activity of native and dual modified rice flours by using in vitro antioxidant methods such as DPPH,ABTS and FRAP. The findings showed native rice flour samples exhibited highest antioxidant activity, when compared to dual modified rice flour samples. Due to heat moisture and enzyme treatment, loss of some phytochemicals resulted in less antioxidant properties.

Keywords: Free radicals, Antioxidants, Anthocyanins, Chronic illness

INTRODUCTION

Free radicals are highly reactive chemical entities that contain one or more unpaired electrons and are produced in biological systems as a result of regular metabolic activity or exposure to the environment (Prabha and Vasantha., 2011;Ganie et al., 2014). Free radicals may react with and damage to biomolecules such as DNA, proteins, and membrane lipids, leading to the development of a wide range of chronic illnesses including cardiovascular disease, neurological disorders, cancer, diabetes, and ageing (Devasagayam et a., 2004). Antioxidants help to prevent illness by neutralising excess free radicals and shielding cells from the harmful consequences of free radical damage (Pham-

Huy et al., 2008; Alam et al., 2013). Natural phenolic antioxidants may efficiently scavenge free radicals(Brewer, 2011). Natural bioactive phytochemicals such as phenolic compounds, flavonoids, carotenoids, vitamin C, and vitamin E have been shown to have antioxidant action (Brewer, 2011; Podsędek, 2007). The high amount of proteins, vitamins (vitamin B, riboflavin, and niacin), minerals, and being a rich source of antioxidants, black rice is one of Asia's most essential grains (Yawadio et al., 2007). The rice kernel's black colour is caused by a high anthocyanin concentration. For a long time, black rice anthocyanins were thought to be an important component of various health-promoting functional foods due to their antioxidant properties (Nam et al., 2006; Philpott et al., 2006). Kong and Lee (2010) investigated the phenolic and anthocyanin contents as well as their antioxidant activity in different milled fractions, these compounds being considered one of the molecular markers (Velioglu et al., 1998).Temperature and heating duration had a substantial influence on total anthocyanin concentration and total antioxidant activity, according to Guoling et al., (2013). Cooking was shown to reduce the amount of anthocyanins in black coloured rice by about 70%, whereas cooking reduced the average concentration of phenolics in red-pigmented rice by 26% (Maisuthisakul and Changcub, 2012). Furthermore, Saikiaet al. (2012) discovered that heat significantly decreased the phytochemical and antioxidant capabilities of uncooked black rice. When exposed to heat or temperature, these molecules have a tendency to degrade into smaller stable forms that may or may not have antioxidant action. Temperature and heating time had a significant impact on total anthocyanin content and total antioxidant activity. Heat Moisture Treatment (HMT) and enzymatic modification are essential processes before absorption in the human body as they affect digestibility (Walter et al., 2005). Based on these considerations, the dual modification applied in this study was a combination of two processes such as enzymatic modification and heat moisture treatment(HMT). The objective of this study was to determine and compare antioxidant activity of native and dual modified rice flours by using different in vitro antioxidant methods

MATERIALS AND METHODS

Preparation of rice flour samples

Rice (*Oryza sativa L.)*varities such as Samba -White Ponni and Black Kavuni rice purchased from local organic shop at Tiruchirapalli district , Tamil Nadu, India were selected as samples. Each rice variety was ground separately in an analytical mill and then passed through 100 mesh sieve . They were termed as Native White Rice Flour (NWRF) and Native Black Rice Flour (NBRF).Then dual modified samples were prepared by applying techniques enzymatic modification and heat moisture treatment(HMT). The obtained samples are labelled as Dual Modified White Rice Flour (DMWRF) and Dual Modified Black Rice Flour (DMBRF).

Sample preparation for antioxidant assays

Each of the rice flour sample was weighed (1g) and extracted with 10 mL of methanol for 72 hr at room temperature. After 72 hr, the homogenate were centrifuged at 10000×*g* for 15 min and the supernatants were pooled and stored at 4 °C.

DPPH (2,2′-diphenyl-1-picrylhydrazyl) radical scavenging activity

The radical scavenging potential of the samples was calculated using a modified Sogi et al.(2013) formula. The extracts free radical scavenging activity was calculated using the scavenging activity of the stable 1, 1-diphenyl-2-picrylhydrazyl. The sample extracts were taken at varied concentrations and the volume was adjusted to 1 ml with methanol. Then 3 ml aliquot of DPPH 0.004 % methanolic solution was added to the aliquots of samples and standards (BHT) and vigorously shaken. A negative control was made by dissolving 1 mL of methanol in 3 mL of methanolic DPPH solution. The tubes were allowed to stand at 27°C for 30 minutes. At 517 nm, the absorbance of the samples and control was measured against methanol as a blank. The samples were represented as IC_{50}, which is the sample concentration necessary to inhibit 50% of the DPPH concentration.

ABTS(2,2'-azino-bis-3-ethylbenzothiazoline-6-sulfonic acid) radical scavenging activity

The reduction power of the samples was calculated using a modified version of the approach developed by Arumai Selvan et al. (2018). Allowing an aqueous solution of 7 mM ABTS to react with 2.4 mM potassium persulfate in the dark at room temperature for a maximum of 16 h yielded ABTS. Prior to the test, the 2, 2′-Azino-Bis-3-Ethylbenzothiazoline-6-Sulfonic Acid (ABTS) solution was diluted in ethanol to roughly 1:89 v/v and kept at 25 °C for equilibrium to read the absorbance value of 0.700 0.02 at 734 nm. The test solution was made by combining 1 mL of the diluted ABTS solution with about 30 L of extract and 10 L of Trolox (final concentration ranging from 0 to 15 M) in ethanol. The negative control was made up of 1 mL of diluted ABTS solution and 30 L of ethanol. After incubation, the absorbance of the extract and standards (BHT) was measured at 734 nm against an ethanol blank. The samples were represented as IC_{50}, which is the sample concentration necessary to inhibit 50% of the ABT concentration.

Ferric reducing antioxidant power (FRAP)

The antioxidant contents of phenolic extracts of samples were consideration according to the procedure explained by Pulido et al. (2000). FRAP reagent (2.7 mL), made freshly and incubated at 37°C, it was mixed with 270 µL of distilled water and 50 µL of extract or methanol (for the reagent blank). The test sample and reagent clear were brooded at 37°C for 30min in a water shower. The last weakening of the test in the response blend was 1/34. The FRAP reagent making 2.5 mL of 20 mM/L TPTZ (2,4,6-tripyridyl-s-triazsine) arrangement in 40 mM/L HCl in addition to 2.5 mL of 20 mM/L $FeCl_3 \cdot 6H_2O$ and 25 mL of 0.3 m/L acetic acid derivation support (pH 3.6) . Toward the finish of hatching, the absorbance readings were taken quickly at 593 nm. Results were ascertained in ferrous sulfate counterparts.

RESULTS AND DISCUSSION

DPPH Radical Scavenging Activity

The rice flour extracts were able to convert DPPH, a stable free radical, to diphenylpicrylhydrazine, a yellow compound. This demonstrates that rice flour extracts include active components capable of donating hydrogen to a free radical in order to remove an odd electron, which is responsible for the radical's reactivity. The DPPH radical scavenging technique has been shown to be effective. Because the results are unaffected by the polarity of the substrate. In this study, different concentrations were used to evaluate the DPPH antioxidant activity from 0.1 to 0.5. The highest antioxidant activity was observed in NWRF from 17.492 to 45.662. The least antioxidant activity was observed in DMBRF from 11.169 to 24.095. In overall, the DPPH scavenging activity of Dual modified samples decreased drastically, when compared to native white flour and black flour (Fig. 1). Soaking during hydrolysis incubation deteriorated some water-soluble pigments of coloured rice flour (Sompong et al., 2011). The IC_{50} values of DPPH scavenging activity was high for all the samples when compared with standard(Fig.2). The IC_{50}concentration inversely proportional to the activity of the samples. Noorlaila et al (2018) revealed that the boiled black rice , resulted in reduction of DPPH scavenging activity from 88.29- 52.06% .This shows effect of processing had impact on antioxidant properties of rice flour.

ABTS radical scavenging activity

As ABTS is a blue chromophore generated by the interaction of ABTS and potassium persulfate, the scavenging activity of ABTS radical by the native and dual modified rice flour was found to be significantly reported. The addition of rice flour extracts to this preformed radical cation converted this to ABTS in a concentration-dependent manner. When the findings were compared to those obtained using the conventional BHT value, it was discovered that the extract has significant antioxidant properties (Wang et al., 1998). In ABT, assay also the highest antioxidant activity was observed in NWRF from 7.285- 49.182 %. The least antioxidant activity was observed in DMBRF from4.406-30.597 %. In overall, the native white and black rice flour extracts having the strong antioxidant activity, when compared to dual modified rice flour extracts (Fig .3). Due to the heat moisture and enzyme treatment, loss of some phytochemicals results in less antioxidant activity. Our results were similar to that of Sungsopha et al.,(2009)

results. In this assay also the IC_{50} was found to be low in both native rice flour(Fig.4), when compared with dual modified rice flour samples. Low value of IC_{50} results in high antioxidant activity.

FRAP activity

FRAP (Ferric reducing antioxidant power) is a well-known and preferred technique for assessing antioxidant activity (Saura-Calixto et al., 2009). Fig.6 presents FRAP activity of native and dual modified rice flour samples. In overall the highest FRAP activity was found to be in native black rice flour from 12.47-14.88 and followed by native white rice flour from 3.57-7.52.This result was similar to that of Sompong et al. (2011).However, in both white and black dual modified rice flour samples FRAP activity decreased, when compared to the native rice flour samples. This might be attributed due to the enzyme and heat moisture treatment ,which produced loss of some antioxidant compounds and resulted in decreased FRAP activity.

CONCLUSION

Processing methods play a vital role in food product development. It was observed from this study the enzymatic and heat moisture treatment applied, significantly reduced the antioxidant activities. The findings of the study will be applied in formulation of black rice flour based food products and provides scope in food industries.

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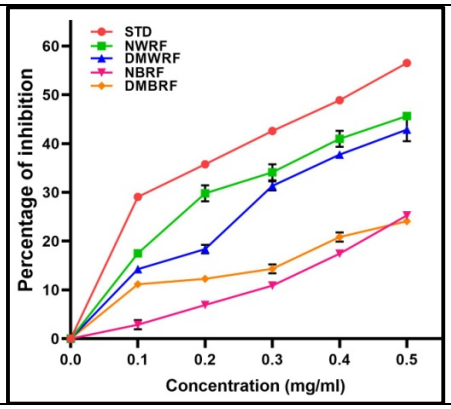

Figure 1: DPPH scavenging activity of NWRF, DMWRF, NBRF and DMBRF

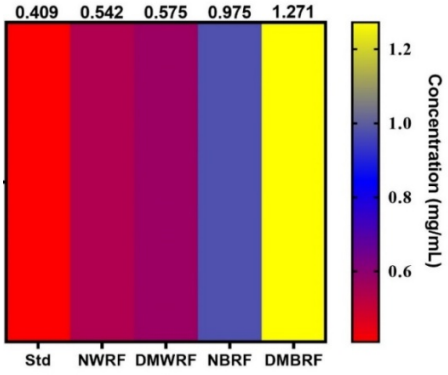

Figure 2: IC_{50}values for NWRF, DMWRF, NBRF and DMBRF

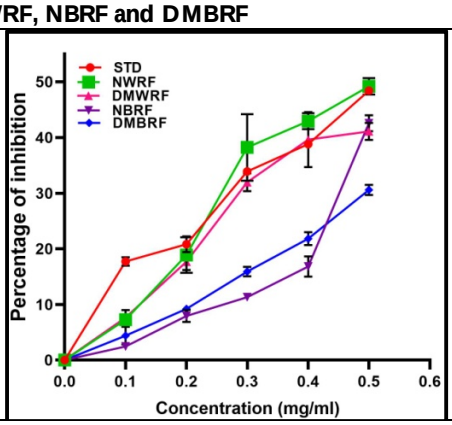

Figure 3: ABTS scavenging activity of NWRF, DMWRF, NBRF and DMBRF

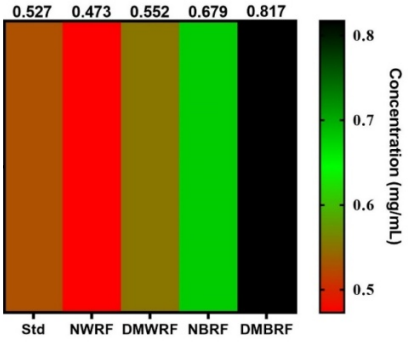

Figure 4: IC_{50}values for NWRF, DMWRF, NBRF and DMBRF

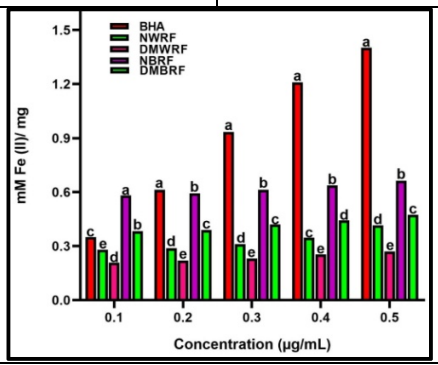

Figure 6: FRAP activity of NWRF, DMWRF, NBRF and DMBRF

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RESEARCH ARTICLE

Aggregated Multiple Ensemble based Mortality Prediction in ICU Patients

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ABSTRACT

Identifying the probability of mortality plays a crucial role in the treatment monitoring process. Effective identification can reduce unnecessary hassles and aid doctors in drug administration. This work presents an Aggregated Multiple Ensemble (AME) model for mortality prediction. The AME model is constructed in four phases; data analysis and integration, feature augmentation and encoding, model construction and result aggregation. The first two phases acts as the entities to build qualitative training data that contains all the highly correlated components to accurately predict mortality levels. The latter phases operate on building the model and providing predictions. Experiments were performed on MIMIC III data, and the obtained results indicate high accuracy levels of 80%. Comparison with existing state-of-the-art models indicate 14% increase in accuracy levels, exhibiting the high performing nature of the model.

Keywords: Mortality Prediction; MIMIC III; Ensemble Modelling; Boosting; Voting Aggregator

INTRODUCTION

Quantifying the health of patients and predicting the future outcomes from the current health state is a very crucial aspect of critical care research. Mortality probability and length of stay of a patient are vital and significant factors in determining the clinical outcomes [1]. These factors can be effectively identified by determining the severity of the illness, which in-turn determine the treatments to be provided for a patient. Identifying these crucial entities has remained and still is a complicated process for health care practitioners [2]. Identifying such factors aid in identifying

the status of a patient and also is necessary for allocation of resources for the patient. Intensive Care Units (ICU) suffer from shortage of doctors, nurses, and also medical equipment. Identifying the severity of the health issue can aid in appropriate allocation of these resources [3]. Further, real-time identification of mortality can also aid the physician to get a good understanding of the patient, and thus can be used to employ appropriate measures, or end of life treatments. With the advent of digitization, digital maintenance of clinical records is being practiced in most hospitals [4]. These records can be effectively leveraged to apply machine learning models and perform predictions. Machine learning is one of the widely used data mining techniques [5]. In-patient mortality prediction using data mining techniques is one of the recently researched domains [6]. Mortality prediction is a form of binary classification problem. However, the intrinsic data distributions and formats creates several challenges in creating a classification model for mortality prediction. The initial problem is that the input data is time series in nature [7]. Patient progress is generally recorded based on time. Hence, this requires progressive analysis of patients [8]. The next challenge is, even if the model provides high accuracy, doctors cannot take the predictions as such. They generally require interpretability in their predictions [9]. Although several deep learning models provide high predictions, issues with the interpretability levels is a major cause for concern, and hence many doctors are not enthusiastic about using them [10]. Further challenges include the descriptive nature of data, and highly complex nature of the data [11]. The data contains several categorical feature, which leads to huge explosion of features, when converted to numerical formats. This tends to increase the data complexity to a large extent. The remainder of this paper is structured as follows; related works are presented in section 2, data description is provided in section 3, architectural description of the proposed model is provided in section 4, results and discussions are provided in section 5, comparison study is presented in section 6, and the work is concluded in section 7.

Related works

Machine learning has played a vital role in the domain of mortality prediction. This section discusses some of the most prominent and recent works in this domain. A mortality prediction model that considers imbalance has been proposed by Li et al. [12]. This work uses the balanced random forest algorithm for mortality prediction. Hyper-parameter is tuned based on the geometric mean measure, and the model also uses feature extraction in the preprocessing module to identify highly correlated features for prediction. This ensures improved prediction efficiency. An artificial neural network based model for mortality prediction was proposed by Ding et al. [13]. This technique has been designed for early prediction of the mortality levels. The downside of this model is that it is highly specific in nature, and hence cannot operate of other similar data. An ensemble based modelling approach for mortality prediction of patients in Intensive Care Unit (ICU) was proposed by Awad et al. [14]. The model uses multiple learning algorithms like Random Forest, Decision Tree and Naïve Bayes for ensemble creation. A model that analyzes the factors which play a vital role in determining the mortality of patients was proposed by Mandalapu et al. [15]. The model performs the analysis by feature extraction, followed by applying the extracted features over multiple machine leaning models. This method aims to identify the factors that influence weekend mortality predictions. A machine learning based model for predicting mortality in patients with brain injury was proposed by Rau et al. [16]. The model is composed of two sections. The first section deals with identifying the parameters required for the prediction process from clinical data. The second phase uses multiple machine learning algorithms for prediction. A real-time mortality prediction model for patients in ICU was proposed by Johnson et al. [17].

Analysis scores has been developed to identify the discriminatory power of models in the domain of mortality prediction. General ICU prediction models involve prediction models that include, The Simplified Acute Physiology Score-II (SAPS-II) [18], Mortality Probability Model after 24 h-II (MPM24-II) [19] and Acute Physiology and Chronic Health Evaluation–II (APACHE-II).A mortality prediction model based on Sequential Organ Failure Assessment (SOFA) score has been proposed by Schoe et al. [20]. The SOFA score is used as the major feature, in combination with the general ICU prediction models to determine the mortality level of the patient. A rapid scoring model for mortality prediction in COVID patients was proposed by Hu et al. [21]. This technique uses a combination of scoring models for prediction. The downside of such models is that they are statistical in nature, and mostly do not involve machine learning process. This handicaps them from using the model on future data for predictions. Deep learning

models have become the main components in domains requiring feature extraction as a major component. The domain of mortality prediction also exhibits such requirements, hence the current decade has seen increase in the usage of deep learning models in this domain. An analysis of existing deep learning models used on healthcare domains was performed by Purushotham et al. [22]. In addition to analyzing these models, this study also benchmarks them to provide a clear view of the working process. A deep learning model used specifically for predicting mortality in children was proposed by Kim et al. [23]. This is a convolution neural network based model that uses two layers of one-dimensional convolution operations. Interpretability is generally an issue in deep learning models. This issue has been solved by Che et al. [24], that includes the interpretability component in ICU outcome prediction. A model that uses Long Short Term Memory (LSTM) components in deep learning networks to for mortality prediction was proposed by Jo et al. [25]. This technique uses a combination of LSTM and latent topic modelling to perform the prediction process. Although highly effective deep learning models are computationally intensive, resulting in resource intensive requirements, which might not be feasible for most real-time environments.

Dataset Description

MIMIC III (Medical Information Mart for Intensive Care) is a database of clinical information about patients admitted into critical care from the Beth Israel Deaconess Medical Center in Boston, Massachusetts [26]. It is a freely available database, which contains measurements, notes by caretakers, observations by doctors, procedures, diagnosis information, survival data etc. The following are the data files that are available in the MIMIC III data (Table 1).

Aggregated Multiple Ensemble (AME) for Mortality Prediction

Mortality prediction is a risk prediction model that aids in effectively providing end of life treatments. Mortality prediction is performed by analysis of clinical information about patients. The prediction process is highly complex due to a large number of influential factors contained in the data. This work proposes an Aggregated Multiple Ensemble (AME) model for mortality prediction. The proposed model is composed of four phases; the initial phase performs data analysis and effectually integrates multiple data containing vital clinical and patient related information, the feature augmentation and encoding phase analyzes the integrated data to provide the numerical training data, the multiple ensemble creation phase creates and trains the ensemble model, and finally the result aggregation phase integrates the decision rules to provide the final predictions.

Data Analysis and Integration: MIMIC III is the clinical data used for analysis. The data is divided into multiple files, each file representing a specific aspect of the patient, such as, clinical measurements, physiological parameters, caretaker details, admission details etc. These data files need to be analyzed to identify the parameters that effectively aid in the mortality prediction process. This is a manual process, as most of the data are categorical in nature, and requires contextual analysis to filter the required parameters. It was identified that the required parameters were available in the data files; admission details, ICU details and patient details. Admission details file contains demographic and ethnic information of the patient, ICU details file contains the stay and measurement details, and patient details file contains the physiological parameters and the mortality status of the patient. All these data files are integrated based on the patient identifier.

Feature Augmentation and Encoding: The initial phase performs integration of large number of features. Most of the features are categorical in nature, as they are obtained from various departments of the hospital. Such features are not directly usable in machine learning context. Hence they are augmented and encoded appropriately to obtain the training data. Date of birth and diagnosis details are the major features that are augmented. Date of birth details is stored in object format. This feature actually represents the age component, which is a significant feature exhibiting high correlation with the mortality prediction. Hence age component is augmented from the date of birth feature. Similarly, the diagnosis component also exhibit high correlation with the mortality levels. Analysis reveals that this feature is composed of 15241 unique entries. The data is made compact by performing a value based count, and by integrating all the values exhibiting less than 20 entries into a single component. This process reduces the unique entries to a large extent. The next step is encoding of categorical attributes. Existing categorical attributes are one-hot-

encoded to determine the numerical data. Mortality status is provided by the 'expiry flag' parameter. This parameter is maintained as a binary value, hence is maintained as such. Since multiple files are integrated, there remains possibility of null values. Prior to imputation, instances containing null value in the 'expire flag' attribute are eliminated. All the other null values are mean imputed to obtain the training data.

Multiple Ensemble Model Creation: The encoded training data contains large number of features. Hence the data requires a complex model for analysis. This work proposes a multiple ensemble model for the prediction process. Ensemble is the process of creating multiple models and integrating their results to obtain the final results. The ensemble model is proposed to exhibit better predictions compared to the individual models. Hence, ensemble models, by nature are more complex compared to conventional machine learning models. Due to the highly complex nature of the input data, this work creates multiple ensembles for enhanced prediction. The base ensemble model used for this process is the Gradient Boosting Classifier. The gradient boosting classifier is a boosting based ensemble model, which uses a single base learner and fine-tunes it iteratively to reduce error levels. This work uses three instances of the Gradient Boosting Classifier, each fine-tuned with a different hyper-parameter set. The number of instances used for ensemble modelling can be varied according to the data complexity and the time requirements. The value of three has been determined by a combination of domain analysis and trial and error. The training data is divided into multiple overlapping subsets. Each subset contains at least 60% of the training data. Each section of the data is passed to one instance of the gradient boosting classifier. Every model operates only on a part of the training data. Further, due to the presence of carried hyper-parameters, each model identifies different decision rules. The training process, hence creates three varied set of rules for the training data.

Result Aggregation: In order to handle the highly complex nature of the input clinical data, the proposed ensemble modelling phase creates multiple prediction models. This ensures appropriate handling of the high dimensional and highly complex data. The multiple decision rules are aggregated in this aggregation phase to provide a more powerful model. Test data is passed to all the created model instances, and predictions are obtained. Multiple predictions are obtained for each instance of the test data. These predictions are integrated by the process of voting based aggregation to obtain the final results. Voting based aggregation is given by

$Prediction = argmax(V_0, V_1)$

Where V_0 is the number of votes for class 0 and V_1 is the number of votes for class 1.

RESULTS AND DISCUSSION

The proposed AME model has been implemented using Python. Performance analysis has been performed by applying the model on MIMIC III data. The input data has been split into training and test data in the ratio of 4:1, where 80% of the data is used for training, and 20% of the data is used for testing. The obtained results is shown in Table 2. Precision, Recall and F1-Score for each of the classes is shown in the table, along with the accuracy obtained from the AME model. The metrics were derived using the below formulae.

$$TPR\ (or)\ Sensitivity\ (or) Recall = \frac{TP}{TP + FN}$$

$$Precision\ (or) PPV = \frac{TP}{TP + FP}$$

$$F1 - Score = \frac{2 * Precision * Recall}{Precision + Recall}$$

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN}$$

Comparative study

A comparative analysis of the proposed AME model with the Artificial Neural Network based model proposed by Ding et al. [13] has been performed and shown in Figures 1 and 2, and tabulated in Table 2. Comparisons were performed in terms of Sensitivity, Specificity, Accuracy, PPV and NPV. Formulae for the metrics is given below.

$$Specificity = \frac{TN}{TN + FP}$$

$$NPV = \frac{TN}{TN + FN}$$

ROC curve representing specificity and sensitivity in x and y-axes respectively is shown in figure 1. Curve exhibiting the higher area-under-the-curve is considered to exhibit best performances. It could be observed that the curve pertaining to the proposed AME model exhibits higher area compared to the curve modeled using metrics from Ding et al. This shows that the proposed model exhibits enhanced performances. Comparison of performance in terms of all the metrics discussed is provided in Figure 2. It could be observed from the figure that except for the slight reduction in NPV, the proposed AME model exhibits high performance on all the other metrics. Tabulated view of the performance comparison is provided in Table 3. The best performances are provided in bold. It could be observed from the table that the AME model exhibits higher performance on all metrics except for NPV, which exhibits a reduction level of 3%. In terms of the other metrics, an increase in accuracy at 14%, increase in sensitivity at 13%, increase in specificity at 14%, and increase in PPV at 11% were exhibited by the proposed AME model. The increase in performance is attributed to the ensemble based modeling and the presence of multiple ensembles in the model.

CONCLUSION

Mortality prediction is of significant importance for patients, hospitals and doctors, because of the monetary and resource based savings associated with accurate predictions. The process however, is complicated by the nature of the data and the complexity of the data. This work presents an Aggregated Multiple Ensemble (AME) model to perform mortality prediction. The proposed model performs effective feature extraction and data preparation to obtain the training data, followed by the aggregation based training model to operate on the highly complex training data. Usage of multiple ensemble based training models ensures that the model handles the high dimensional data effectively to identify the decision rules. Experiments were performed using MIMIC III data, and the results obtained exhibits accuracy levels of 80%, with sensitivity levels of 79% and specificity of 80%. These exhibit the high performing nature of the model. Comparisons with existing model indicates 14% improved accuracy levels. In conjunction with the performances, the proposed model is highly interpretable in nature, making it suitable for real-time usage. Although performances exceed in comparisons, the model still has scope for improvement in performances. Future extensions of this work will analyze the model in terms of imbalance levels to improve the performances.

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Table 1: Data Files in MIMIC III data

ADMISSIONS	D_ICD_DIAGNOSES	INPUTEVENTS_CV
CALLOUT	D_ICD_PROCEDURES	INPUTEVENTS_MV
CAREGIVERS	D_ITEMS	LABEVENTS
CHARTEVENTS	D_LABITEMS	LICENSE
CPTEVENTS	ICUSTAYS	MICROBIOLOGYEVENTS
DATETIMEEVENTS	PROCEDUREEVENTS_MV	NOTEEVENTS
DIAGNOSES_ICD	PROCEDURES_ICD	OUTPUTEVENTS
DRGCODES	SERVICES	PATIENTS
D_CPT	TRANSFERS	PRESCRIPTIONS

Table 2: Performance of AME Model

	Precision	Recall	F1-Score
0	0.89	0.8	0.84
1	0.67	0.79	0.73
Accuracy			0.8

Table 3: Performance Comparison of AME and Ding et al.

	AME	Ding et al.
Accuracy	**0.8**	0.66
Sensitivity	**0.79**	0.666
Specificity	**0.8**	0.661
PPV	**0.67**	0.563
NPV	0.88	**0.916**

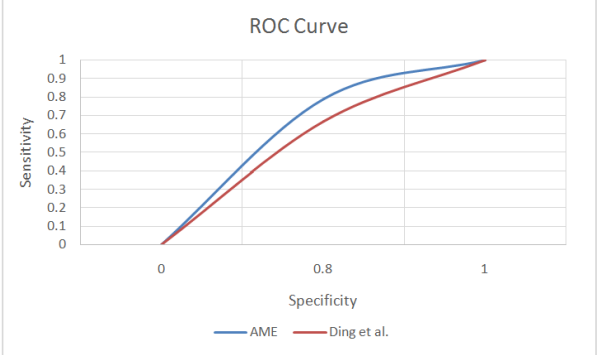

Figure 1: ROC Performance Comparison of AME

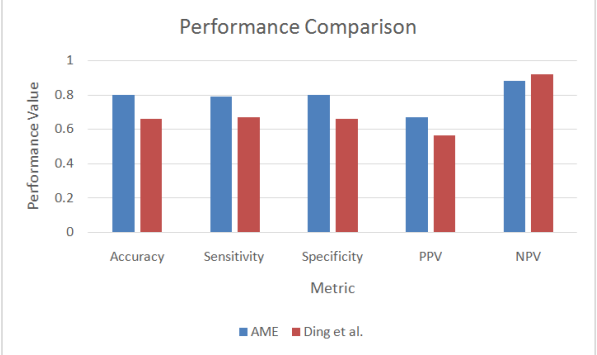

Figure 2: Metric based Performance Comparison of AME

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SHORT COMMUNICATION ARTICLE

An Observational Study on the Analgesic usage in the Surgical Departments of A Secondary Care Hospital

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ABSTRACT

Since pain is multifactorial in nature, understanding both its complexity and side effects is imperative to attaining a positive surgical outcome. The extensive use of analgesics in pre-operative and post-operative pain management, apart from being irrational in most circumstances, has led to an increased cost-burden on the patient. This study aimed to evaluate the rationality of the analgesics prescribed and assess their use before and after surgery, including adherence to guidelines. This prospective observational study included 90 patients operated in the surgical departments of Orthopedics, General Surgery and Gynecology of a secondary care hospital. A total of 90 patients were included in the study out of which, the majority of the cases were clean wounds (58.8%), with the most frequently conducted surgery being K-wiring and ORIF (Open reduction internal fixation). The most widely prescribed analgesics were paracetamol, aceclofenac + serratiopeptidase, and diclofenac. About 65.6% of all the cases shown correct choice of analgesic, while 77.8% of the cases had correct doses, the frequencies of the analgesics prescribed were as per the guidelines in 74.4% cases and the adherence of prescribed analgesics to the existing guidelines was found to be22.2%. The analgesic use for pre-operative and post-operative pain management was divergent from the guideline recommendation due to lack of hospital guidelines, ineffective formulary management, influence of pharmaceutical companies.

Keywords: surgical, doses, hospital, Surgery, effects.

Pain is undoubtedly multifaceted, and understanding its complexity and side effects is vital to achieving an effective surgical outcome [1,2]. Over 8% of patients who undertake surgical procedures experience acute postoperative pain and approximately 75% of those with post-operative pain report the severity as moderate, severe or extreme. Many

preoperative, intraoperative, and postoperative interventions and management strategies are accessible and continue to evolve for reducing and managing postoperative pain [3]. Pain assessment embroils more than just quantifying the intensity of pain. High pain intensity ratings or behavioral scale score that do not respond to usual care should be probed to conclude whether the pain might be due to a different medical issue or surgical complication and the potential role of opioid tolerance and psychological distress [2]. Systemic opioids might not be required in all patients and the recommendations state that clinicians offer multimodal analgesia, or the use of a assortment analgesic medications and techniques combined with non-pharmacological interventions, for the treatment of postoperative pain (strong recommendation, high-quality evidence)[2]. Uncontrolled postoperative pain may lead to significant clinical, psychological, and socioeconomic consequences resulting in increased morbidity and mortality, delayed recovery, unanticipated readmissions and chronic persistent postsurgical pain [1].

Clinical practice guidelines are ‘‘guides’’ only and might not be applicable to all patients and all clinical settings. As part of a collective decision-making approach, it might be appropriate for the clinician to inform a patient that a particular recommendation might not be appropriate, after considering all circumstances pertinent to that individual [3,4]. A prospective observational study was conducted for a period of two months (January – March 2020) at a secondary care hospital. All in-patients undergoing surgery and admitted in general surgery, orthopedic and gynecology wards of the hospital were included in the study whereas pediatric population (<12years) and patients undergoing surgeries in other wards were excluded from the study. Institutional Ethical Committee approval was obtained before the commencement of the study. The data of 90 patients were collected–33 patients from Orthopedics, 48 patients from General Surgery and 9 patients from Gynecology. Tools used in the study were WHO Analgesic Ladder [5,6,7,8] and Wong Baker pain scale.

Majority of the patients were from the Department of General Surgery (48) patients had comorbidities while 52 patients had no comorbidities and the average duration of hospital stay was 5.02 days. Clean surgery (63.3%) category accounted for the maximum number of surgeries, followed by clean contaminated (23.3%), contaminated (7.7%) and dirty (4.4%).K-wiring accounted for most frequent surgery conducted in the Department of Orthopedics whereas in the Department of General Surgery and Gynecology, it was Appendectomy and Hysterectomy respectively. Orthopedic surgery accounted for the most number of analgesics used and Paracetamol, Aceclofenac + Serratiopeptidase, and Diclofenac were the three most commonly prescribed medications.

The appropriateness of the choice of analgesics, its dose and frequency were compared with WHO pain ladder based on the pain score reported on the patient medical record. Fromatotalof90cases,65.6%ofthecasesshowedcorrectchoice of analgesic whereas in 1.1% of the cases, the appropriateness of the analgesic prescribed could not be determined due to incorrect recording of pain score or pain score not recorded. The frequencies of the analgesics prescribed were as per the guidelines in74.4%casesandnotknownin 3.3% of the analgesics prescribed. The overall adherence of prescribed analgesics to the guidelines was found to be22.2% (Table 3).

The appropriateness of the choice, dose and frequency of administration of the analgesics prescribed were determined on the basis of WHO pain ladder and related recommendations. The appropriateness of some of the analgesics were classified as “not known” when the pain score was missing from the case record. Out of the 90 cases, in 38 cases, the analgesics’ choice, dose and frequency were all found to be appropriate and as per the recommendations put forward by the WHO pain ladder. The usage patterns of analgesics in the pre and post-operative pain management were clearly shown in the study. In 40 cases, a single analgesic was given for pain, whereas, 34 cases used two analgesics and three or more analgesics were given for pain in 16 number of cases. The most commonly prescribed single analgesic was Paracetamol whereas the most frequent combination was Aceclofenac + Serratiopeptidase. The adherence to standard guidelines for the use of analgesics in pre and post-operative settings was calculated as 22.2%.

Low adherence rate of the prescribed analgesics to the hospital guidelines maybe attributed to factors like the clinician's prior experience, the differences in the perception of pain from patient to patient and the fact that the guidelines might not be applicable to all patients in all clinical settings. The reliability of pain score in assessing the pain of the patient may also need reconsideration here, though there is not sufficient evidence to conclude that regular pain assessment using a pain assessment tool is not clinically relevant [5]. A qualitative study conducted on 27 patients one day post-op recounted that before reporting the pain score to the nurse, patients measured up the possible consequences (i.e., probable judgments by professionals and anticipation of analgesic administration) of their choice of pain score [6]. Furthermore, the interpretation of the pain score by different health care professionals could also have played a role in decreasing the adherence of analgesic prescription to the guidelines [7].

In former studies, the use of the WHO three-step analgesic ladder to treat pain resulted in acceptable analgesia in approximately 69 to 100% of the patients [8] and is currently acknowledged as global health strategy and one of the major advances in the treatment of patients with pain [9,10,11]. In this study, the pain scores were the indicators for measure of adequate analgesia in the patients.

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CONFLICT OF INTEREST

Declarations of interest: none.

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Table 1: Baseline Characteristics of the Study Subjects

Variables	n =90	Percentage
GENDER		
Male	51	56.67
Female	39	43.33
AGE in years		
Below 20	15	16.67
21-40	27	30
41-60	28	31.11
61-80	17	18.88
≥80	3	3.33
DEPARTMENT		
Orthopedic	33	36.67
General surgery	48	53.33
Gynecology	9	10
LENGTH OF STAY		
0-5	49	54.44
6-10	33	36.67
≥10	8	8.88
WOUND CLASS		
Clean	57	63.33
Clean-contaminated	21	23.33
Contaminated	7	7.77
Dirty	4	4.44
TYPE OF SURGERY		
K wiring	20	22.22
ORIF	10	11.11
Hysterectomy	6	6.66
Appendectomy	5	5.55
Hemorrhoidectomy	4	4.44

Anal dilation	4	4.44
Laparotomy	3	3.33
Hernia repair	3	3.33
PFN	3	3.33
D&C	3	3.33
Implant removal	3	3.33
Others	26	28.89

Table 2: Prescribed analgesics

ANALGESICS	n=277
Paracetamol	50
Aceclofenac + Serratiopeptidase	37
Diclofenac	31
Tramadol	27
Pregabalin	31
Flupirtine	9
Morphine	6
Mefenamic acid	2
Others	84

Table 3: Appropriateness of prescribed analgesics as per guidelines

Parameters	n = 90	%
Correct choice	59	65.6
Correct dose	70	77.8
Correct frequency	67	74.4
Adherence to guidelines	37	22.2

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RESEARCH ARTICLE

Drug Utilization Evaluation of Antibiotics used in General Medicine Department in a Tertiary Care Hospital of Pathanamthitta District, Kerala

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ABSTRACT

Drug Use Evaluation (DUE) or Drug Utilization Evaluation is the management of continuous, precise, criteria-based assessments of the use of drugs, which will warrant that the drugs are being used relevantly, which is at the discretion of the patient. The aim of the study is to determine the drug utilization evaluation of Antibiotics used in the general medicine department at a tertiary care hospital; to assess the culture sensitivity with various antibiotics and identify the most effective antimicrobial against the organism isolated. A prospective observational study was used for the assessment. A sample size of 109 patients who had undergone the antibiotics treatment was selected for this study. The descriptive of the sample study shows 61.47% of the patients are male and 38.53% are female. Age-wise distribution found that 35.78% of the patients were predominant, within the age group of 61-80 years, followed by 29.36% in the age group of 41-60 years. Analysing the use of antibiotics on the study sample reveals that 37.62% of the patients received only Cephalosporins, 23.86% received Penicillins, and less by other antibiotics. The most predominant cephalosporin prescribed in this study was Cefoperazone and sulbactam combination (43.3%). In the study of isolation of organisms, only very few samples undergone culture and sensitivity tests. In this, it was found that 68.75% were Gram – ve and 25.0% Gram + ve organisms. But it was also found that 6.25% were Gram +ve and Gram –ve organisms. Drug utilization review of antibiotics is an important tool for health care professionals to identify the effective use of antibiotics.

Keywords: Drug Utilization Evaluation; Antibiotics; General medicine; Culture sensitivity Test.

INTRODUCTION

Drug Use Evaluation (DUE) or Drug Utilization Evaluation is the management of continuous, precise, criteria-based assessments of the use of drugs, which will direct that the drugs are being used wisely, which is at the extent of the patient[1]. Drug use evaluation is a necessary element of the drug use quality refinement procedure. It is an execution enhancement technique to optimize patient outcomes [2].Drug utilization studies are prevailing tools to establish the role of drugs in society. They provide a sound socio-medical and health economic basis for healthcare decision-making. To achieve this, it is very important to determine the drug use pattern and to monitor the drug use profiles, overtime. The WHO specifies drug use indicators for adoptions in the drug utilization studies. Drug utilization evaluation aims to assess whether drug therapy is rational or not. To reach this goal, methods for auditing drug therapy towards rationality are necessary. Drug utilization evaluation can be divided into descriptive and analytical studies. The World Health Organization (WHO) has repeatedly emphasized the importance of drug utilization studies and developed indicators to examine trends of prescribing and the health facilities. Once irrational drug use in its various forms is determined, feasible means of intervention are tried with the hope to improve drug use [3]. The DUE studies have a promising impact both locally and internationally as they are relentlessly used as an indicator of the healthcare system. Prescribing patterns frequently utilize techniques to assess the agreement of doctors who prescribe according to standard treatment guidelines as well as rational prescribing practices[4–6].Inappropriate use of the drug can also result in a hike in medical cost, development of antimicrobial resistance, ADR, and mortality of patients. Therefore, drug utilization (DUE) studies become one of the impending tools in the assessment of the health program [7,8].

Antimicrobials are agents which are used to eradicate or edge the growth of microorganisms. These microbes are accountable for the root cause of infectious diseases. The main mechanisms for the devastation of microbes by the antimicrobials are the effect of drug molecules on the cell structure, the effect of metabolic steps which are not usually found in the host body, or the attraction of microbes to the biomolecules [9]. Antibiotics are the agents obtained from one of the microorganisms and these agents are confirmed in their efficacy on other microorganisms at a fixeddose. Depending on the activity of the microbes, they are classified as bacteriostatic and bactericidal. The use of antibiotics is to treat the established infections and also thwart infections [10]. An increase in the rate of morbidity and mortality can be barred with the help of the judicious use of antibiotics. At the same time, one of the prime factors for the increase of antibiotic resistance is the overuse and underuse of antibiotics. In India, negligence of treatment guidelines and dearth of information regarding the proper use of medications are some other reasons behind the increase of antimicrobial resistance [11]. Antibiotic resistance was recognized by the World Health Organization as a serious phenomenon that has emerged due to the pervasive prescription of antibiotics in practice. The development of bacterial resistance to antibiotics has become a major problem throughout the world. Resistant organisms may emerge as are sult of many factors, including wide spread usage, while their spread is mainly caused by factors in the healthcare setting, including the healthcare provider's behavior. This tool was adapted by pharmacists to assess the appropriateness of usage of various medications [12]. The key action by the clinician should be the provision of a specimen for accurate identification of the offending pathogen by means of culture and sensitivity method [13]. Information about antibiotic use patterns is necessary for a constructive approach to problems that arise from the multiple antibiotics available [14]. Various studies have reported that there are deficient treatment plans especially in the selection of molecules, setting of frequency, and duration in the prophylactic antibiotic treatment [15].

The importance of antimicrobial sensitivity checking are

- To check the most appropriate effective antibiotics against the isolated organisms
- To reduce ADR by inappropriate antibiotics
- To reduce the dysfunction of normal flora by other antibiotics
- To check the drifts in the alteration of antibiotic therapy [16].

Most commonly, empirical therapy is effective over some microbes because they show no resistance to the pathogens [17]. The study aims to determine the drug utilization evaluation of Antibiotics used in the medicine department at tertiary care hospitals. This study also aims to assess the culture sensitivity with various antimicrobials and to identify the most effective antimicrobial against the organism isolated.

METHODOLOGY

In this study, a prospective observational study was used and it is conducted at the General medicine department of a tertiary care hospital. A sample size of 109 patients, who had undergone antibiotics treatment was included and selected for this study. Patients were included with their consent or willingness to participate in the study. Patients, who discontinued their treatment and expressed their non-willingness to participate in the study, were excluded. All subjects were provided with a brief introduction regarding the study and confidentiality of the data. A written informed consent printed in understandable language was obtained from the patient or caregiver. Relevant information was collected according to the approved pre-designed data collection form. Data of each subject was individually screened to assess the drug utilization pattern of antibiotics used in treatment periods. The culture and sensitivity reports were also collected to identify the most effective antibiotics against the isolated organism. The data was then statistically analyzed. The data collected was entered as well as analyzed using Microsoft Excel (2010 version) and the results are presented below in tabular form as absolute numbers and percentages supplemented with graphs for easy interpretation.

RESULTS AND DISCUSSION

The study result shows that among 109 patients, 61.47% of the patients were male and 38.53% were female. Age-wise distribution of the patients was analyzed and it was found that 35.78% of the patients were within the age group of 61-80 years, followed by 29.36% in the age group of 41-60 years, 22.02% in the age group of 20-40 years, 7.34% less than 20 and 5.5% in the were greater than 80. In the study, on analysing the type of cases undergone, it is noted that the most common conditions were Septicemia with a percentage of 17.43%, followed by Pneumonitis 13.76%,Typhoid fever 12.84%, Chronic obstructive pulmonary disease (COPD), Acute gastroenteritis 11.93%, Cellulitis, Meningitis 9.17%, Hepatic encephalopathy 7.34%, and Urinary tract infection 6.42%.The distribution of patients based on disease status is shown in Table 1. Analysing the use of antibiotics on the study sample reveals that 37.62% of the patients received only Cephalosporins, 23.86% received Penicillins, 11.93% received Macrolides, 11% received Fluoroquinolones, 4.59% received Carbapenams, 3.66% received aminoglycosides, 2.76% received Oxazolidinone, 1.84% received Tetracyclines, 1.83% received a combination of Cephalosporins and Fluoroquinolones and 0.91% received a combination of both cephalosporins and penicillins. No patients received sulphonamides. Assessment of the type of Antimicrobial used is shown in Table 2.

On analysing the use of Cephalosporins on the sample it is found that 43.3% of the patients had been administered with a combination of Cefoperazone and Sulbactam, followed by 38.7% with the combination of Ceftriaxone and tazobactam, 9.0% with Cefuroxime, 6.8% with ceftriaxone alone and 2.2% with a Cefpirome. Assessment of the use of Cephalosporins is shown in Table 3. The study sample was assessed with a Culture and Sensitivity test and it was found that only 14.68% of the patients performed the test and the majority of the patients, that is 85.32% did not perform the culture and sensitivity test. The results of the culture and sensitivity study show that in 43.75% of the cases blood and urine specimens were used, and 12.5% of throat swab were used as a specimen. It was found that 68.75% were Gram – ve and 25% Gram + ve organisms were identified in the samples. However, it was also found that 6.25% were mixture of both Gram +ve and Gram –ve organisms. In this study, different strains of organisms were isolated from a patient's specimen for culture. Among the isolated organisms 31.25% were *Klebsiella spp*, 25% were *E. coli*, 12.5% *Streptococcus pneumonia*, 12.5% were *Staphylococcus aureus*, 6.25% were *Candida* Species, *Pseudomonas spp,* both *E. coli& S. aureus.* No growth of *Enterococci, Proteus mirabilis, Monrgrenella morganii* were seen.

The distribution of organism isolated was shown in Table 4. Antibiotic susceptibility showed that most of the *candida* species are sensitive to Linezolid, *E.coli* strains are sensitive to Ofloxazin followed by meropenem, Piperacillin, and tazobactam. *Klebsiella spp* was found sensitive to Ceftriaxone, Cefoperazone and Sulbactam followed by the combination of Piperacillin and Tazobactum. *Pseudomonas spp* was found sensitive to Cefoperazone and Sulbactam. *Streptococcus pneumonia* was found sensitive to Cefoperazone and Sulbactam. *Streptococcus aureus* was found sensitive to a combination of Ceftriaxone. *E. coli& S. aureus* was found sensitive to Meropenem. The study was conducted to evaluate the drug use pattern of antibiotics in the general medicine department at Tertiary care hospital, Pathanamthitta District, Kerala. This study also aims for the assessment of culture and sensitivity with several antibiotics and to identify the most effective antimicrobial agent against the isolated organisms.

Age-wise distribution was analyzed and found that most of the patients who got treatment in the general medicine department were in the age group of 61-80 years followed by 41-60 years which agrees with the common concept of the need for treatment is related to age, chronic illness, worsening of body function, which is the same in many countries. The study was conducted by assessing the case reports of 109 patients, which revealed that the study population was predominantly male (61.47%) while females made (38.53%) of the sample studied. This can be attributed to the fact that in Kerala, the educational and income status of males plays a key role in utilizing the facilities related to health care. In this study, it was arrived at that the most common disease condition was Septicemia (17.43%) followed by Pneumonitis (13.76%), Typhoid fever (12.84%), COPD, and Gastroenteritis (11.93%). It was found that the most commonly prescribed antibiotics were Cephalosporins (37.62%) followed by penicillins. Among cephalosporins, the most predominantly used antibiotic was a combination of Cefoperazone and Sulbactam(43.3%) followed by a combination of Ceftriaxone and tazobactam (38.7%). Our study correlates with the study conducted by Aiswarya et al. [18,19]and Philip et al. [20]. In this study, one of the objectives was to assess the culture and sensitivity testing in the study sample. Extended use of antibiotics may lead to an increased hospital stay, which in turn may lead to an increase in the cost of treatment and most importantly increased antimicrobial resistance. Observing the use of Antimicrobial sensitivity is very crucial to provide the treatment effectively and also reduces the spread of resistance of the microorganisms[21].

In this study, the majority of the patients have not performed the culture and sensitivity test (85.3%). Out of 16 collected specimens for culture and sensitivity testing, all the specimens showed growth. 68.75% were Gram-negative organisms were 25.0% gram-positive and 6.25% were both gram-positive and gram-negative organisms. A large percentage of the microorganism isolated was *Klebsiella spp*(31.25%) followed by *E. coli* (25.0%). This study gives an insight into the microbial pattern isolated from the patients in the tertiary care hospital. The drug of choice according to culture and sensitivity plays an important role. The precision of the selection of an antibiotic is very important in an effective therapy. Failure in the selection shows resistance to the particular pathogen. In this study, *Klebsiella spp* was most sensitive to the combination of cefoperazone and Sulbactam, ceftriaxone (4cases) followed by a combination of Piperacillin and tazobactam (1 case). *E. coli* was more sensitive to ofloxacin (2 cases) followed by meropenem (1 case).*Staphylococcus aureus* was most sensitive to ceftriaxone (2 cases). On antimicrobial susceptibility testing, Cefoperazone and Sulbactam were found to be the most effective drug due to the sensitivity of the majority of the isolated organism. The next most effective antibiotics were Ceftriaxone followed by meropenem.

CONCLUSION

The precision of prescribing is determined by the accessibility, safety, effectiveness, value range of sensitivity, specific site action, tiniest resistance, and hypersensitivity to the patient population. Drug utilization review of antibiotics is an important tool among health care professionals to identify the effective use of antibiotics. This study concludes that the antibiotics were administered therapeutically for the treatment. These agents were administered both orally and intravenously. The most widely used antibiotics were third-generation cephalosporins, that is, Cefperazone- Sulbactam combination and ceftriaxone and tazobactam. Penicillins, a combination of Piperacillin and

tazobactam. Only very few of the samples underwent culture and sensitivity tests, where blood and urine samples were the most commonly used specimens and mostly isolated organisms were gram-negative organisms. Among gram-negative organisms, *Klebsiella spp*was the most abundantly isolated organism followed by *E. coli*. Cefoperazone and Sulbactam combination and ceftriaxone were the most effective drug because the majority of the organisms were sensitive to these drug combinations. The continuous assessment of prescription patterns of antibiotics is important to enhance the decision of the prescribers to be most beneficial for the patients. By evaluating the prescribing pattern continuously, health providers can improve the effectiveness of the treatment, thus resulting in improved patient contentment by fulfilling the positive therapeutic outcome.

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CONFLICT OF INTEREST

The authors have none to declare.

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Table 1. Distribution of Patients based on disease status

TYPE OF DISEASE	FREQUENCY (n=109)	PERCENTAGE (%)
Typhoid fever	14	12.84
Chronic obstructive pulmonary disease (COPD)	13	11.93
Pneumonitis	15	13.76
Urinary tract infection	7	6.42
Cellulitis	10	9.17
Acute gastroenteritis	13	11.93
Septicemia	19	17.43
Hepatic encephalopathy	8	7.34
Meningitis	10	9.17

Table 2. Assessment of type of Antimicrobial used

ANTIBIOTIC	FREQUENCY	PERCENTAGE
Cephalosporins	41	37.62
Penicillins	26	23.86
Fluoroquinolones	12	11.0
Sulfonamides	0	0
Oxazolidinone	3	02.76
Carbepenams	5	04.59
Tetracyclines	2	01.84
Aminoglycosides	4	03.66
Macrolides	13	11.93
Cephalosporins+Penicillins	1	00.91
Cephalosporins+Fluoroquinolones	2	01.83

Table 3. Assessment of use of Cephalosporins

CEPHALOSPORINS	FREQUENCY (n=44)	PERCENTAGE
Cefoperazone+ Sulbactum	19	43.3
Ceftriaxone + tazobactum	17	38.7
Cefpirome	1	2.2
Cefuroxime	4	9.0
Ceftriaxone	3	6.8

Table 4. Distribution of Organism isolated

Organism Isolated	Number of Cases	Percentage (%)
Candida Species	1	6.25
E. coli	4	25.0
Enterococci	0	0
Klebsiella spp	5	31.25
Monrgrenella morganii	0	0
Proteus mirabilis	0	0
Pseudomonas spp	1	6.25
Streptococcus pneumonia	2	12.50
Staphylococcus aureus	2	12.50
E. coli& S. aureus	1	6.25

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RESEARCH ARTICLE

Beverage Consumption and Premenstrual Syndrome

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ABSTRACT

Premenstrual syndrome, a group of symptoms which will occur during the luteal phase of the menstrual cycle. Some of the studies have concluded that beverage consumption reduces the risk and severity of premenstrual syndrome. The objective is to correlate the effect of beverage consumption during premenstrual syndrome. This is an observational study conducted in different colleges. The total sample of300womenwere selected within the age group of 18-27years. The tool used in this study was Premenstrual Syndrome Screening Tool and Self – Reported Questionnaire, which was used to correlate the effect of beverage consumption during premenstrual syndrome. The results suggest that 13%women consumed lime juice during premenstrual syndrome whereas 6% consumed orange juice as well as lemon with mint, followed by 4% who consumed pomegranate juice during PMS, which was statistically significant at ($P<0.001$). Our findings suggest that beverage consumption helps to decrease the severity and prevalence of premenstrual syndrome. These findings provide future direction for the research on various other beverages which helps to reduce the PMS. There is lacuna in the literature regarding the beverage consumption of women with premenstrual syndrome. Some of the researches have mainly focused on the advantage and disadvantage of beverages consumption in women with premenstrual syndrome. Many of the researchers have proven, consumption of carbohydrate drinks premenstrual syndrome. Calcium intake of 1,200 mg/day is associated with a significant decrease incertain pre-menstrual symptoms. Hence the study is aimed to analyse whether there is any relationship between the beverage consumption in premenstrual syndrome.

Keywords: Luteal phase, Premenstrual syndrome, menstrual cycle, premenstrual syndrome screening Tool, Self- reported questionnaire**.**

INTRODUCTION

Premenstrual syndromeis a common condition that occurs in women before the menstruation. It affects more than 90% of menstruating women. However, the causes of PMS are unknown. This may be due change in both sex hormones and serotonin levels at the beginning of the menstrual cycle. Levels of oestrogen and progesterone increase during certain times of the month. An increase in these hormones can cause psychological symptoms such as mood swings, anxiety, and irritability. There are several different symptoms that have been associated with PMS, but the symptoms are cyclic and recurrent [1]. Many of the studies have proven that beverage consumption helps to reduces the risk and severity of premenstrual syndrome [2]. A diet rich in carbohydrate will help to enhance the mental performances. Some of the studies have proven that consumption of carbohydrate drinks will help to decrease the depression, anger and confusion [3]. The present study aimed to analyze the beverage consumption is helps to decreases the premenstrual syndrome.

METHODS

This study was conducted in engineering colleges and community. The sample size of the study was 300 who were recruited through simple random sampling. In the present study, premenstrual syndrome screening tool and self-reported questionnaire was formulated and validated by Clinical Dietitian, Academician and statistician. The premenstrual syndrome screening tool consists of three categories such as Psychological symptoms, Physical symptoms and Behavioural symptoms. In each category 7 to 8 symptoms are listed out with the severity of scoring and number of days. Self – reported questionnaire contains the usual demographic data with the different types of beverages and its frequency of consumption. The study has been carried out among women within the age group of 18-27years in engineering colleges and community. The premenstrual syndrome screening tool has been circulated among the subjects. Those participants who have more than 7 symptoms were considered as women with premenstrual syndrome. Self- reported questionnaire was used for the selected subjects to correlate the beverage consumption and premenstrual syndrome.

Statistical Analysis

Number of samples used	N=300(With a relative precision of 15% and confidence level of 95%,The required sample size is 100 in each group
Statistical tools	Two-way ANOVA Chi-square Test
Level of significance	<0.0001

RESULTS

We found that there is a strong association between the beverage consumption during Premenstural syndrome. The [figure 1] showed the percentage distribution of participants. Majority of women were from the age group 18-22years (51%). The [table 1] depicts the height and weight of the participants with mean and standard deviation. Mean and standard deviation of height and weight is 164±10.9 and 67±12.[Figure 2 & 3] describes the percentage of menstrual cycle regularity and percentage of beverage consumption during premenstrual syndrome. The [table 2] describes the number and the percentage distribution of each and every symptom listed in the premenstrual syndrome screening tool. The [table 3, figure 4, table 4 and figure 5] explained the percentage of different beverage consumption during premenstrual syndrome. 13% of women consumed lime juice during premenstrual syndrome, 6% consumed orange

juice as well as lemon with mint, followed by 4% who consumed pomegranate juice during PMS, which was statistically significance at p (<0. 001). There seems to be correlation between beverage consumption and premenstrual syndrome. The [table 5] showed the consumption of other beverages during premenstrual syndrome which was statistically significant at P (<0.001).

DISCUSSION

The study carried out by Calam et., al 1991 suggests that consumption of mint with any beverage may benefit to relieve from the premenstrual syndrome and menstrual disorder, but the mechanism is unknown. The study conducted by raja sayegh et., al 1995 describes that, high carbohydrate rich drink consumption may help to decrease the psychological symptoms of premenstrual syndrome by maintaining the serum tryptophan levels. In this study, we have found that there is a strong association between the consumption of beverages during premenstural syndrome. Especially, in the present study, we have concluded that many of the women (13%) were consuming lime juice during PMS. Many of the researches have been concluded that consumption of citrus fruits during PMS helps to alleviate the symptoms which are related to nervous system. In this study, we have used two questionnairesi.e Premenstural syndrome screening tool and self-reported questionnaire. Premenstural syndrome screening tool is the only tool, which was used to collect the symptoms that they were having during PMS. We have also listed out the severities and also we have categorized into three types. In this questionnaire, we have listed out 25 symptoms, out of that most of them had (50% of people) increased appetite, uncontrolledanger, hypersomnia and abdominal pain,15-20% of people had symptoms of mood swings, irritability, lethargy and breast tenderness.

Self-Reported questionnaire was the tool which was used to correlate the effect of beverage consumption during Premenstural syndrome. In this questionnaire we have listed out 25 beverages. We have declared about the quantity of consumption and also frequency. In that, most of the women have been consuming lime juice during PMS. Cross *et,.al* evaluated the consumption of carbohydrate rich drink during PMS.They found that there is a strong correlation between carbohydrate rich drink and PMS [6]. Prior Research have found that, carbohydrate intake helps to reduce the prevalence and severity of the Premenstural syndrome. Among these previous studies, findings have been inconsistent. Nagata *et.,al* evaluated that there is no strong association between the carbohydrate drink consumption during PMS[7],but in the other hand Johnson *et.,al* concluded that macronutrient intake was found to be positively associated with decrease in the severity of Premenstrual syndrome[8]. Relatively low intake of dietary fibre has a significant inverse association with dietary fibre intake and menstrual pain. Primary dysmenorrhea occurs only during the ovulatory cycles [9]. Adequate uterine exposure to the oestrogen and then to the hormone progesterone is necessary. Some of the studies have suggested that fibre intake decreases the blood oestrogen levels in women [10]. Rossingal *et.,al* found that there is strong correlation between sweet tasting foods and consumption during PMS. He concluded that sweet tasting foods helps to decreases the severity of PMS and also found that high intake of caffeine containing beverage will increases the severity of PMS[11].

CONCLUSION

In conclusion, we did not observe the strong correlation between the beverages and PMS, at the same time beverage consumption were also not associated with increase in PMS. Hence, beverage consumption helps to decrease the severity of Premenstrual syndrome.

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Table 1: Mean ±SD of the Anthropometric Measurements of the Subjects

ANTHROPOMETRY	MEAN±SD	INFERENCE
HEIGHT (cms)	164±10.9	155
WEIGHT (kgs)	67±12	60
BMI (kg/m$^{2)}$	23±1.12	24

Table 2: Percentage distribution of PMS symptoms

S.no	Symptoms	None		Mild		Moderate		Severe		Very severe	
		N	%	N	%	N	%	N	%	N	%
1	Depression	73	24	41	14	110	37	43	14	27	9
2	Anxiety	57	19	27	9	177	59	23	8	16	5
3	Mood swings	144	48	16	5	49	16	50	17	41	14
4	Irritability	58	17	15	7	35	16	142	47	50	15
5	Anger	17	16	54	18	40	13	43	14	146	49
6	Poor Concentration	64	12	33	11	98	33	70	23	35	12
7	Decreased in usual activity	60	20	57	19	43	14	124	42	16	5
8	Lethargy	58	17	15	7	35	16	142	47	50	15
9	Breast Tenderness	56	18	60	20	10	35	39	13	41	14
10	Headache	64	12	33	11	98	33	70	23	35	12

11	Abdominal pain	17	16	54	18	40	13	43	14	146	49
12	Vomiting	60	20	57	19	43	14	124	42	16	5
13	Generalised tiredness	53	18	29	10	46	15	75	25	97	32
14	Constipation	125	42	100	33	40	13	11	4	24	8
15	Swelling in hands and feet	180	60	72	24	16	5	12	4	20	7
16	Increased appetite	74	24	20	7	92	31	47	16	154	51
17	Food cravings	83	28	58	19	20	17	92	30	47	16
18	Insomnia	171	57	49	16	23	8	22	7	38	12
19	Short temper	56	18	60	20	10	35	39	13	41	14
20	Uncontrolled anger	74	24	20	7	92	31	47	16	154	51
21	Hypersomnia	74	24	20	7	92	31	47	16	154	51
22	Avoidance of social contact	17	16	54	18	40	13	43	14	146	49

Table 3: Percentage Distribution of Lime Juice during PMS

FREQUENCY	RESPONSES	% OF CONSUMPTION	CHI-SQAURE	P-VALUE
Nil consumption	152	51	26.7	<0.001**
Daily	6	2	6.4	
Thrice a week	28	9	35.8	
Twice a week	26	9	25.8	
Once in a week	48	16	19.4	
During PMS	40	13	127.9	

**- Significant <0.001

Table 4: Percent distribution of lemon with mint juice during PMS

FREQUENCY	RESPONSES	% OF CONSUMPTION	CHI-SQUARE	P-VALUE
Nil consumption	240	80	0.383	<0.001**
Daily	3	8	10.834	
Thrice a week	9	3	0.02	
Twice a week	7	2	0.8803	
Once in a week	24	1	0.105	
During PMS	17	6	10.1212	

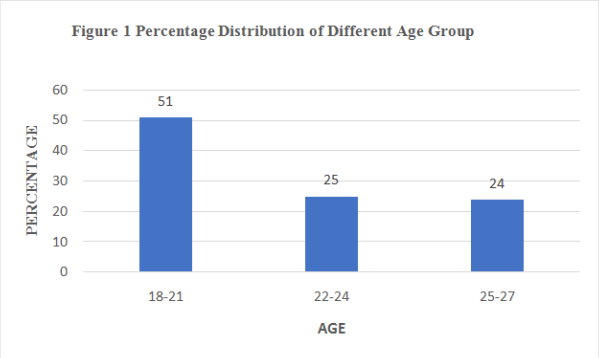
**- Significant <0.001

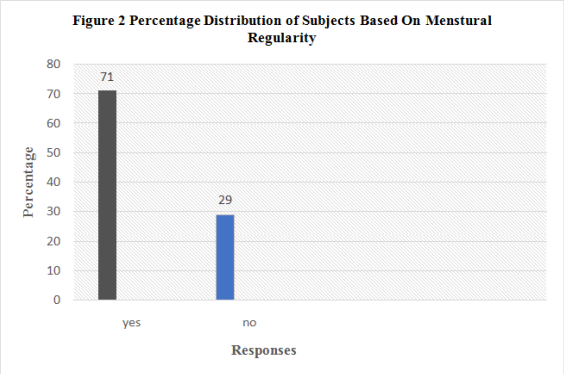
Table 5 consumption of other beverage during PMS

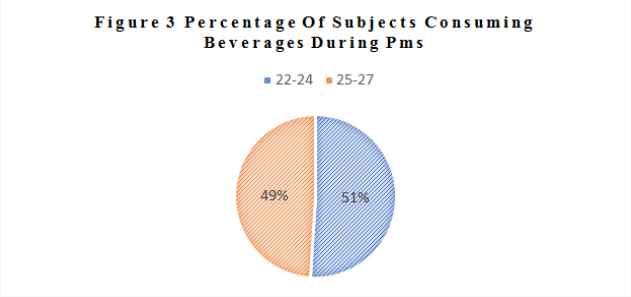
Consumption of other beverage during PMS	P-VALUE
tea consumption during PMS	<0.0001**
coffee consumption during PMS	<0.0001**
lemon tea consumption during PMS	<0.0001**
sukku consumption during PMS	<0.0001**
black tea consumption during PMS	<0.0001**
hot chocolate drink consumption during PMS	<0.0001**
butter milk consumption during PMS	<0.0001**

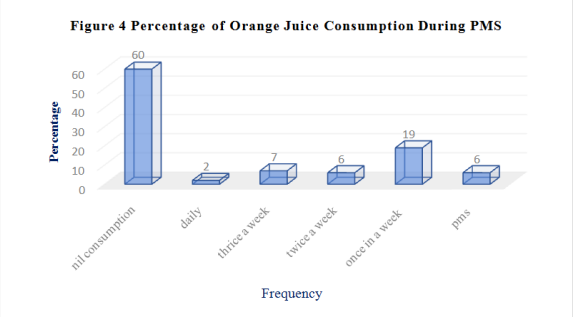
lime juice consumption during PMS	<0.0001**
Pomegranate juice consumption during PMS	<0.0001**
Orange juice consumption during PMS	<0.0001**
mossambi juice consumption during PMS	<0.0001**
watermelon juice consumption during PMS	<0.0001**
apple juice consumption during PMS	<0.0001**
pineapple juice consumption during PMS	<0.0001**
lemon with mint juice consumption during PMS	<0.0001**

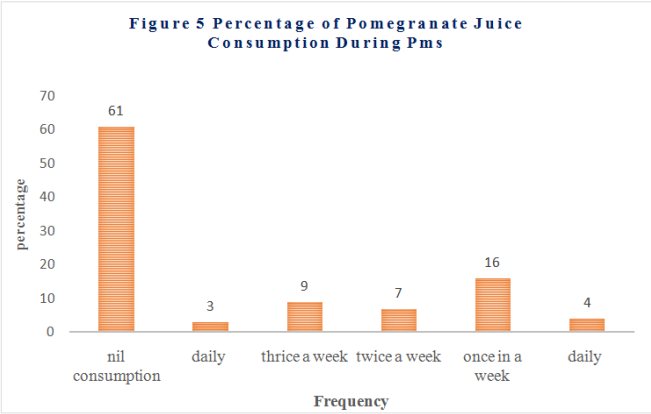
**- Significant <0.001











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RESEARCH ARTICLE

Structural, Textural and Geochemistry Characterization of Alkaline Syenite from Pakkanadu and Pikkili Alkaline Carbonatite Complex in Southern Granulite Terrain, India

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ABSTRACT

The Syenite were formed during the Late Proterozoic in the northern part of South India and displays close relationship with a diverse group of Peninsular Gneissic complex and contains many rock formations from mafic to ultramafic composition. This ultramafic complex corresponds to the alkaline magmatism, which were intruded into the country rock and widely distributed at Kamaneri, Chindamaniyur and Semmandapatty in Salem districts and Pikkili surrounding areas in Dharmapuri districts of Tamil Nadu. Twenty samples were collected randomly to assess the textural characteristics and trace elemental concentration in the rocks of Pakkanadu alkaline complex. The textural orientation closely confirms the textural properties of Syenite rock, such as leucocratic, medium to coarse grain, equigranular alkaline rock showing hypidiomorphic texture and consisting of K-feldspar (microcline), pyroxene, amphibole with accessory minerals such as plagioclase feldspar, magnetite, sphene, zircon, calcite and apatite. The petrography results also show that both crustal and mantle-derived rock compositions and their texture demonstrate their source. The ferromagnesian and transitional trace element data reveal that magma derived from a Sub continental lithospheric mantle source with ultramafic affinity. The elemental distribution is mainly controlled by the process of magmatic differentiation.

Keywords: Alkaline rocks; Textural properties; Trace elements; Geochemistry.

INTRODUCTION

The Southern Granulite Terrane is a collection of crustal blocks, which were integrated together at different times from Neoarchean to the most recent Neoproterozoic – Cambrian [1, 2]. The Sothern Granulite Terrain is facilitating a

wide assortment of unmetamorphosed with great extent of undeformed alkaline magmatic suites including syenites, ultrapotassic rocks, carbonatites, lamproites and shonkinites, which are occurring as intrusives, lensoidal, dykes and association that are generally within or proximal to major paleo-suture/shear zones or metamorphosedfaults [3]. The northern part of Southern Granulite Terrain experienced profound crustal fracture and distinctive lithology, structure by virtue of magmatic and metamorphic history viewed as Dharmapuri Suture Rift Zone (DSRZ) [4, 5]. The extension of DSRZ is controlled by different structural features like Jawadi hill lineament in the east, Mettur-Palakkadu lineament in the west, in the north Palar lineament and Palghat-Cauvery shear in the south. Evolution history of DSRZ is divided into two phases; I) Collisional structural stage and ii) Rifting structural stage. Prior stage of two crustal squares on either side stitching and welding from DSRZ after began to proceed with reactivation of shear zone and improvement of tensional crack just as basic pluton emplacement along NNE-SSW, N-S and ENE-WS trend [6, 7].The alkaline complex structurally associated with metamorphosed hornblende biotite gneissic rock in the Pakkanadu and Pikkili region [8]. Previously numerous of researchers have reported that structural aspects of Pakkanadu and Pikkili alkaline complex [9, 10, 11, 12, 13]. However, the structural interpretation of alkaline complex in Pakkanadu and Pikkili is more complex to understand the origin without petrogenetic characterization. In this present study, we have attempted to understand characterization of alkaline silicate melts and magma differentiation with help of important trace elements concentration and structural signatures in the Pakkanadu and Pikkili alkaline complex.

Study area

The Pakkanadu and Pikkili alkaline Complex belongs to South Indian Granulite Terrain (SGT), which is situated with coordination of N-11º47'09.5" - E77º59'20.8" and N-12º15'24.2"- E78º01'25.6" respectively. Geologically the Pakkanadu alkaline complex comes under Neo-Proterozoic age and mainly composed by Syenite, Carbonatite, Hornblende biotite gneiss and Pyroxinite rock types. The series of Pikkili alkaline complex comes under Paleoproterozoic age and mainly composed by Syenite, Migmatite, Hornblende Biotite Gneiss and Charnockite rock types (Fig.1). The minor foliation and lineation occurs in the Syenite body. The different size width of quartz veins found in the Pakkanadu alkaline complex. The Pikkili village is situated near 16km NW of Dharmapuri town, forms a set of linear residual hills made up of syenite in and around Pikkili village with NNE-SSW trend. The major xenolith structures present in the Pikkili Alkaline Complex. The charnockite body trends N-S direction and the direction of lineation or direction of elongation of mineral grains are in NW-SE 110°.

MATERIAL AND METHODS

Detailed field study was carried out by using topo sheet (58 E/13) published by Geological Survey of India. The sampling stations were marked by geographical coordinates using GPS(Model: GARMIN 76 CSx). The fresh rock samples were collected from the ideal field exposure for laboratory study. The structural features and field relationship of alkaline outcrop was studied in field itself. The collected rock samples were processed for thin section preparation and petrographic study examined by the petrological microscope LEICA-Model DM 2700P, in Department of Geology, Periyar University. The trace elements like Fe, Mn, Pb, Zn, Cu, Cr, Co and Ni were analyzed by AAS (Model: Perkin-Elmer AA700).

RESULT AND DISCUSSION

Petrography: Commonly the rocks from the Pakkanadu alkaline complex contain alkali feldspar mainly orthoclase and microcline, pyroxene, amphibole with opaque. Sphene, apatite, quartz, zircon are the common accessory minerals. Microcline is the most dominant member of the alkaline complex. Under the microscope, Microcline grains are characterized by medium to coarse-grained, equigranular, colorless, non-pleochroic, low relief, and often exhibithypidiomorphic texture. Microcline shows Tartan twinning, Poor to moderate relief, colorless, two cleavages intersecting nearly at right angles on a (100) section. Anisotropic extinction angle 5^0. Coarse-grained pyroxene is

brownish to green colored euhedral, low pleochroic in pink to greenish. Clinopyroxene show parallel extinction, and orthopyroxene show exsolution lamellae. Pyroxene is identified as 90^0 cleavage angle of orthopyroxene. Orthopyroxene show high relief, pleochroic, and pink in color. Amphibole present in green colored subhedral grains, olive-green to dark green pleochroism, two sets of prismatic cleavage intersect cleavage angle at 56°, moderate to high relief, anisotropic. Biotite grains are green in color, brown to black, pleochroic with parallel cleavage. Apatite minerals present as small amounts of the accessory mineral, Fe-Oxides present as opaque mineral. Sphene and zircon occur as minor accessory. Sphene mineral identified by diamond shaped well develop euhedral crystal. Microscopically sphene is brown in color, pleochroic, high relief, twinning present in simple twinning. Euhedralsphene is intergrowth within alkali feldspar (Fig.2).

Geochemistry: The signature of trace element concentration can be utilized to understand the magmatic processes [15, 16, 17]. The concentration of trace elements such as Fe, Mn, Cr, Cu, Pb, Zn, Ni and Co of Pakkanadu and Pikkili alkaline complex are presented in Table 1. Based on the trace element concentration present in alkaline complex of study region show the following sequence of concentration in the increasing order as Fe>Mn>Cr>Ni>Zn>Co>Pb>Cu. The higher concentration of Fe and Mn confirms that presence of pyroxene and amphibole group of minerals in the alkaline complex of the study region. Moderate concentration of Pb suggest that presence of K-feldspar in magma composition. The transitional elements like Ni, Cr, Cu, and Co show the moderate signatures due to the lack of mafic minerals in alkaline complex. The geochemical distribution plots of the alkaline and mafic rocks are plotted (Fig. 3), the plots mostly indicate depleted and enrichment pattern and which reveals that magmatic differentiation play a vital role in the Pakkanadu and Pikkili alkaline complex area.

CONCLUSION

The field characterize of Pakkanadu and Pikkili alkaline plutons and some outcrops were observed from northern part of the study region. The field structural orientation inferred that emplacement of primary, secondary structure development, deformation and metamorphic history of the alkaline complex during the alkaline magmatism. The petrography and geochemistry studies reveals that origin of alkaline rocks, peterogenitic characterization and cooling history of alkaline magma. The ferromagnesian and transitional trace element data reveal that magma derived from a Sub continental lithospheric mantle source with ultramafic affinity. Overall the elemental distribution in the study region is mainly controlled by the process of magmatic differentiation.

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Table 1. Trace elements concentration (ppm) of Pakkanadu and Pikkili alkaline rocks.

S.No	Fe	Mn	Ni	Cu	Cr	Co	Pb	Zn
1	12939	723	51.7	12.1	243.3	34.7	14.4	65.4
2	12889	621	45.3	20.9	213.3	29.8	20.4	69.6
3	8392	57	11.2	1.4	117	5.1	0.6	9.3
4	10676	309	11.3	1.1	23.9	2.3	0.3	8.2
5	1163	41	14	0.5	34.9	3.3	0.1	3.4
6	9798	301	68.1	51.5	161.9	35.3	36.3	62.4
7	12523	436	85.2	18.8	252.3	42.5	44.2	98.4
8	13964	890	1299.2	15.4	2945.2	127.6	40.7	82.9
9	13912	764	1205.2	15.6	1194.2	119.3	45.4	54.7
10	13718	806	1230.9	15.7	1932.7	155.4	40.1	66.9
11	14128	882	1238.4	11.6	1943	121.6	37.8	70.5
12	12675	537	118	51.8	224.8	39.6	27	116
13	14841	1308	152.9	122.8	556.1	66.5	15.2	155.4
14	14376	1134	315.4	85	1120.2	66	31.6	110.7
15	14254	1296	361.6	36.3	1234	74.5	37.8	98

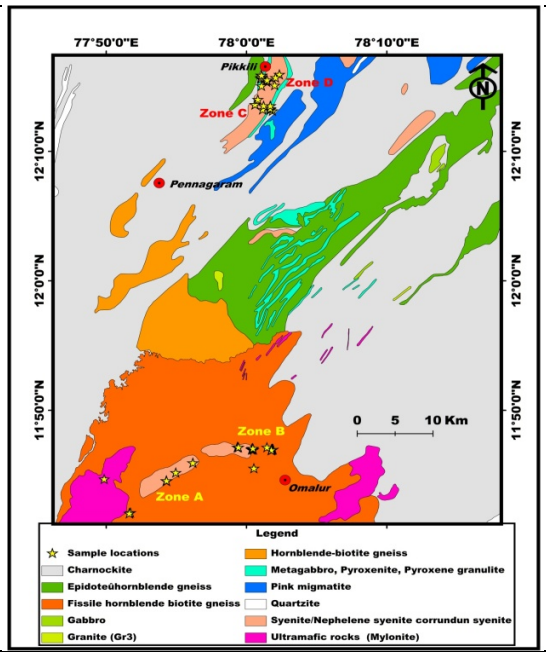

Figure 1: Location map of Pakkanadu and Pikkili alkaline complex

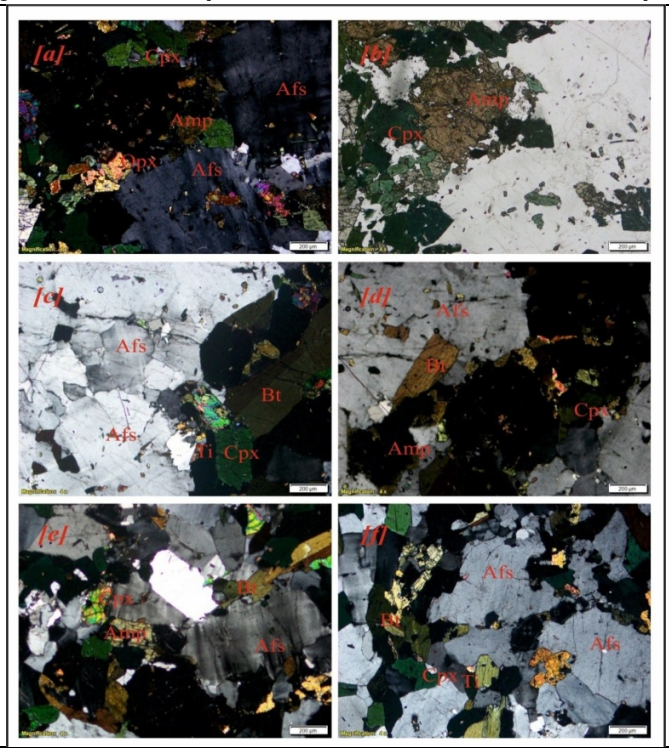

Figure 2: Micro photographs show (a-d), medium to coarse-grained alkali feldspar, which exhibits hypidiomorphic texture. Subhedral to euhedral amphibole shows moderate pleochroism with elongated fibrous biotite. e .Magnetite with Allanite is present in opaque. f. Amphibole rims are developed in pyroxene.

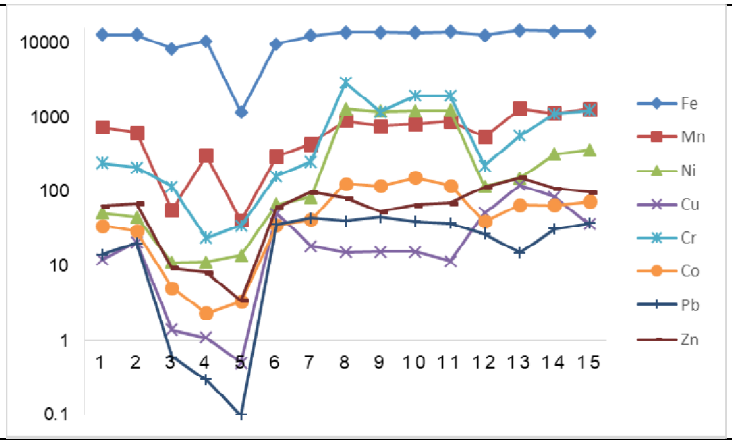

Fig 3: Trace elements concentration diagrams of Pakkanadu and Pikkili alkaline complex

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RESEARCH ARTICLE

Pharmacognostical Study on Thippili Rasayanam- An Ancient Siddha Poly Herbal Formulations for the Management of SARS-COV2 (COVID-19)

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ABSTRACT

The novel corona virus (SARS-COV2) causing a Severe Acute Respiratory Symptoms in patients is called COVID-19. COVID-19 is a serious pandemic problem in the current ERA of the world. Siddha System of Medicine is a valuable medicine which thought various diseases of human beings and medicines for all. Thippli Rasayanam is one of the Siddha polyherbal formulation prescribed for the treatment of COVID-19. It consists of 20 herbal ingredients of different plant species and families. It fall under the category of respiratory illness. This review highlights the biological source, family, geographical source, parts used, vernacular names, siddha properties and actions, pharmacological activities, chemical constituents explored and medicinal uses of the various ingredients of very useful and ancient Siddha polyherbal formulations.

Keywords: Thippli Rasayanam, Corona virus, Siddha system of medicine, Respiratory illness.

INTRODUCTION

Corona virus is a large family of viruses that are known to cause morbidity and high illnesses like Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory syndrome (SARS). The new Coronavirus has never been identified in humans, so even though anti-retroviral drugs are still widely debated, their work claims a very important role in COVID-19 therapeutics, strengthening of antibodies as a preventive solution and therefore the Corona virus is caused by a rapidly differentiating virus that works by injecting a genome into another gene and regenerating itself there so it depends on other factors in its growth and it becomes a serious research topic among drug developers, researchers and scientists [1,2]. In Siddha system, all things within the universe are made of 5 basic elements; land, water, fire, air and space. When the flesh is taken into account to be a mix of three humours and 7 body parts. Any change in environmental conditions like wind, water, habitat and seasonal is taken into account to be accountable for the occurrence of diseases. These environmental, seasonal and waterborne diseases will be compared and treated using the concepts of Siddha Pathology. Epidemics are classified as communicable disease in general within the Siddha program.

The occurrence of diseases is usually recommended based on within the confusion of Mukkutram. The foremost common, infectious diseases, related to respiratory-related illness, is affected to its Sthiram gunshot wound. Gugu Naadi quotes that infectious disease is typically caused by bacteria or microbes. In keeping with Siddha's medical plan, COVID-19 can best be described as an infectious disease caused by a mix of antibodies against a virus or invasive virus. Respiratory illness due to changes in diet, morally and environmentally. Additionally, the symptoms of COVID-19 such as fever, raw throat, headache, shortness of breath, pneumonia and respiratory depression may be compared to those performed by Kaphasuram [3-5]. Use of modern medicine in respiratory disease cases is restricted by their pharmacokinetic properties, secondary failure rates and accompanying side effects. On the opposite hand, within the traditional medicinal practice number of pulmonary tonic herbal drugs and their formulations are popular and reputed. They are prescribed from time to time to the patient's need. Many of the traditional practice formulations are not well established in their scientific parameters. One such traditional pulmonary tonic formulation in Siddha system of drugs is "Rasayanam" formulation, among the several respiratory Siddha formulations within the Siddha formulary of India and Citta Vaittiya Tirattu, an ancient Siddha literature, the "Thippli Rasayanam" are proved to be useful in the management of respiratory diseases.

MATERIALS AND METHODS

It is a literature review study. So in this study the various books, Classical literatures, Scientific Publications, Proceedings and Pharmacopoeias of Siddha system of medicine have been thoroughly studied and complied. Apart from the above exercise and extensive survey among the Siddha physicians available in and around Puducherry with a questionaire has been done to study the various aspects of Thippli Rasayanam and its application in the field of respiratory illness especially towards the COVID-19 symptoms and its management.

RESULTS AND DISCUSSION

Rasayanam

Rasayana is an "increase in rasa", a vital liquid for digestion. Rasa provides nutritious food, improves the system and supports health. Rasayana could be a medical technique in which rasa is kept within the body. The aim of the rasayana is to supply strength, insecurity, vitality, determination, and to strengthen the facility of the mind. Ayurveda teaches that anything that supports and nourishes the blood, known as 'RASA' and supports tissue and therefore the system are called Rasayana treatment. Remedies like tonics, diet and certain physical and mental habits that promote physiological condition and longevity by slowing down the aging process and preventing disease are called Rasayana.

Thippili Rasayanam

Thippili Rasayanam, also referred to as "Pippali Rasayanam" belonging to the Piperaceae family. Mostly Thippili Rasayanam is ready with some ingredients. Pippali Rasayanam has Pippali because it is an excellent ingredient. It is often mixed with confusion and delivered. Thippili or Pippali has several health benefits, which are accustomed treat diseases and increase immunity. Pippali means "drink and grind" and is employed as a spice in Indian cooking. It is known for its various skills like coughing, cold, digestive problems, detoxification, digestive problems and far more, but it should be decided by a certified physician. There are nearly 20 ingredients were found in Thippilirasayanam like Thippili, Milagu, Dry Chukku, Jeeragam Karunjeeragam, Omam, Kurosani Omam, Sitharathai, Perarathai, Kadukkai Thol, Nellivatral, Thandrikkai Thol, Kirambu, Lavangapathiri, Thalisapathri, Kodiveli Veraparuthi, Elam, Lavangapattai, Ghee and Honey. Their biological sources, family, geographical source, parts used are summarized in Table 1.

Vernacular names, Properties and actions, Pharmacological activities of Thippili Rasayanam

Among the 20 ingredients of Thippili rasayanam, all were recognized as herbal ingredients. Plant names are used worldwide and were expanded by the "International Code of Botanical Nomenclature" (ICBN). The name of the plant is different from a particular plant. No other plant in the world will have the same name for plants. Common plant names, in contrast, will vary in different languages or may vary from region to country or may be used in a variety of contrasting plants. Therefore, the name of science is important in associating the righteous ingredient. Traditional scientific names and selected languages for each plant and their properties and actions of each plant are summarized in Table 2 and Table 3.Whereas their pharmacological activities seen in the following Thippili Rasayanam ingredients are summarized in Table 4.

Phytochemical Constituents of Thippili Rasayanam Ingredients [30]

Medicinal plants contain phytochemicals bioactive compounds that produce specific physiological action in the human body. The most important bioactive phytochemical elements are alkaloids, essential oils, flavonoids, tannins, terpenoids, saponins, phenolic compounds and many others. Phytochemical is a natural component of living organisms found in plants, such as vegetables, fruits, flowers, leaves and roots that work with genes to make the immune system or more accurately, protect against disease. Phytochemicals are divided into two groups, namely primary and secondary; according to their functions in the use of the body of the plant. Therefore, the phytochemical content observed in these selected ingredients is reported in Table 5 followed by their medicinal uses are summarized in Table 6.

CONCLUSION

From the above survey, it was observed that Thippili Rasayanam is one of the best formulations in Siddha System for the Management of Respiratory illness including the current outbreak of SARS-COV2 infections. The several ingredients prevent in the formulations has been clearly demonstrated for their selections, identification, authentication and botanical evaluation. The study reveals the chemical constituents and its Pharmacological / Therapeutic application in the management of SARS-COV2 infection. So it can be concluded that the "Thippli Rasayanam" should be explored very well in the Scientific Community, Integrative Medical Physician and even to the public who Thrive to get a better medicine for the Management of Respiratory illness including COVID-19 in the current pandemic world.

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Table 1: Biological source, Family, Geographical source, Parts used of each individual herbal drugs of Thippili Rasayanam [7-13]:

S.NO	BIOLOGICAL SOURCE	FAMILY	GEOGRAPHICAL SOURCE	PARTS USED
1.	*Piper longum*	Piperaceae	Indonesia, Caribbean islands, India	Fruit
2.	*Piper nigrum*	Piperaceae	Indonesia, Malaysia, Brazil, Srilanka	Fruit
3.	*Zingiber officinale*	Zingiberaceae	Southeast Asia, Africa, Australia, India	Dried rhizome

4.	*Cuminum cyminum*	Apiaceae	Morocco, Silicy, India, Syria, China	Fruit
5.	*Nigella sativa*	Ranunculaceae	Romania, Russia, India	Seed
6.	*Trachyspermum ammi*	Umbelliferae	India, Pakistan, Iran, Iraq, Egypt	Fruit
7.	*Hyoscyamus niger*	Solanaceae	Western Asia, North Africa, Europe, India	Seed
8.	*Alpinia galanga*	Zingiberaceae	Eastern Himalayas, Southwest Asia	Rhizome
9.	*Alpinia officinarum*	Zingiberaceae	Eastern Himalayas, Southwest Asia	Rhizome
10.	*Terminallia chebula*	Combretaceae	India(West Bengal, Bihar, Assam)	Fruit
11.	*Phyllanthus emblica*	Phyllanthaceae	Srilanka, Myanmar, India	Dried fruit
12.	*Terminalia belerica*	Combretaceae	India, Srilanka, Malaya	Fruit
13.	*Syzygium aromaticum*	Myrtaceae	Molucca Island, Srilanka, India	Flower bud
14.	*Cinnamomum verum*	Lauraceae	Srilanka, Malabar coast of India, Brazil, Jamaica	Bark
15.	*Taxus wallichiana*	Taxaceae	Canada, India, America	Leaves
16.	*Plumbago zeylanica*	Plumbaginaceae	India,Australia	Root
17.	*Eletteria cardamonum*	Zingiberaceae	Srilanka, Myanmar, Malaysia	Fruit
18.	*Cinnamommum tamala*	Lauraceae	Brazil, Jamaica, India	Leaf
19.	Ghee	-	India, Pakistan	-
20.	*Apis mellifera*	Apidae	Australia, New Zealand, India	Sugar secretion

Table 2: Vernacular names for each individual herbal drugs of ThippliRasayanam [7, 14-17]

S.NO	BIOLOGICAL SOURCE	ENGLISH NAME	SANSKRIT NAME	SIDDHA/TAMIL NAME
1.	*Piper longum*	Long pepper	Pippali	Ampu
2.	*Piper nigrum*	pepper	Pippali	Milagu
3.	*Zingiber officinale*	Ginger rhizome	Ardraka	Ularntainci
4.	*Cuminum cyminum*	Cumin seed	Sveta jiraka	Narcirakam
5.	*Nigella sativa*	Small fennel	Susavi	Aranam
6.	*Trachyspermum ammi*	Cumin	-	Omam
7.	*Hyoscyamus niger*	Henbane	Turusaka	Tippiyam
8.	*Alpinia galanga*	Greater galangal	Rasna	Sitharathai
9.	*Alpinia officinarum*	Lesser galangal	Kulanjanabheda	Perarathai
10.	*Terminalliac hebula*	Myrobalan	Haritaki	Aritaki
11.	*Phyllanthus emblica*	Emblicmyrobalan	Amalaki	Amalakam
12.	*Terminalia belerica*	Belericmyrobalan	Vibhita	Akkantam
13.	*Syzygium aromaticum*	Clove	Lavanga	Kirampu
14.	*Cinnamomum verum*	Cinnamon bark	Tvak	lavankappaddai
15.	*Taxus wallichiana*	Himalayan yew	Manduparni	talisapattiri
16.	*Plumbago zeylanica*	Ceylon leadwort	Chitrak	Kodiveli
17.	*Eletteria cardamonum*	Cardamom	Trutih	Elam
18.	*Cinnamommum tamala*	Indian cinnamon	Tvakapatra	Lavankappattiri
19.	Ghee	Ghee	Go-ghrta	ney
20.	Honey	Honey	Madhu	Thein paani

Table 3: Properties and actions of each individual herbal drugs of ThippliRasayanam [7]

S.NO	BIOLOGICAL SOURCE	Colour	Odour	Taste	Size	Shape
1.	*Piper longum*	Pale to dark brown	Aromatic spicy	Hot and sweet	2-5cm in L, 0.4-0.5cm D	Ovate
2.	*Piper nigrum*	Brownish black	Aromatic	Acrid	1-2cm	Round
3.	*Zingiber officinale*	Buff colour	Aromatic	Pungent	5-15×1.5-6.5cm	Ovate and Oblique
4.	*Cuminum cyminum*	Brown	Characteristic	Aromatic	4-6mm L, 2mm T	Elongated and tapering at ends
5.	*Nigella sativa*	Greenish yellow	Sweet aromatic	Strongly aromatic	5-10×2-4mm	Straight curved
6.	*Trachyspermum ammi*	Yellowish brown	Agreeable	Aromatic	1.7-3mm L,1.5-2.4mm B	Ridges
7.	*Hyoscyamus niger*	Pale greyish green	Strong and characteristic	Bitter and acrid	25cm L	Ovate, Oblong
8.	*Alpinia galanga*	Reddish brown	Aromatic	Aromatic and pungent	2-8cm L, 2cm T	Irregularly branched
9.	*Alpinia officinarum*	Reddish brown	characteristic	pungent	2.8cm L, 6-15mm D	Slightly curved , cylindrical
10.	*Terminalliac hebula*	Yellowish brown	Odourless	Astringent, slightly bitter	20-25mm L 15-25mm W	Ovate, wrinkled
11.	*Phyllanthus emblica*	Green	Odourless	Sore and astringent	1.5-2.5cm in D	Depressed, globular
12.	*Terminalia belerica*	Dark brown	None	Astringent	1.3-2cm L	Globular
13.	*Syzygium aromaticum*	Dark brown	Aromatic	Aromatic and pungent	10-17.5mm L, 4mm W, 2mm T	Long and Narrow
14.	*Cinnamomum verum*	Yellowish brown	Fragrant	Aromatic	1mm L 0.5mm T	Compound quills
15.	*Taxus wallichiana*	Dark green	Bitter	None	1-3cm×1-2cm	Lanceolate, flat
16.	*Plumbago zeylanica*	blackish red	Characteristic	Pungent	30cm L	stout, friable, cylindrical
17.	*Eletteria cardamonum*	Green	Aromatic	Strongly aromatic	2cm length	Ovoid or Oblong
18.	*Cinnamommum tamala*	Dark glossy green	Aromatic	Peppery	7-20cm L	oblong, ovate shaped
19.	Ghee	Golden yellow	Nutty aroma	Tasteless	-	-
20.	Honey	Dark brown	Pungent	Sweet	-	-

Table 4: The pharmacological activities of each individual herbal drugs of Thippli Rasayanam [7, 18-29]

S.NO	BIOLOGICAL SOURCE	PHARMACOLOGICAL ACTIVITIES
1.	*Piper longum*	Respiratory tract, Bronchitis, Tumours, Appetite
2.	*Piper nigrum*	Aromatic, Stimulant, Stomachic, Carminative
3.	*Zingiber officinale*	Stomachic, Carminative, Aromatic, Stimulant
4.	*Cuminum cyminum*	Stimulant, Carminative, Diarrhoea, Dyspepsia
5.	*Nigella sativa*	Carminative, Aromatic, Stimulant
6.	*Trachyspermum ammi*	Antispasmodic, Stimulant, Carminative
7.	*Hyoscyamus niger*	Sedative, Expectorant, Antispasmodic, Antiasthmatic
8.	*Alpinia galanga*	Stimulant, Carminative, Aromatic
9.	*Alpinia officinarum*	Aromatic, Stimulant, Carminative
10.	*Terminalliac hebula*	Astringent, Laxative, Stomachic, Tonic
11.	*Phyllanthus emblica*	Diuretic, Laxative, Bronchitis, Antiasthmatic
12.	*Terminalia belerica*	Astringent, Demulcent, Purgative
13.	*Syzygium aromaticum*	Carminative, Stimulant, Antiseptic
14.	*Cinnamomum verum*	Carminative, Stomachic, Mild astingent
15.	*Taxus wallichiana*	Anticancer, Analgesic, Anti-Inflammatory, Antipyretic
16.	*Plumbago zeylanica*	Laxative, Expectorant, Tonic
17.	*Eletteria cardamonum*	Aromatic, Carminative, Stimulant
18.	*Cinnamommum tamala*	Carminative, Stomachic
19.	Ghee	Anti-cancer
20.	Honey	Anti-bacterial, Anti-microbial

Table 5: Phytochemical constituents of each individual herbal drugs of ThippliRasayanam [7, 31-37]

S.NO	BIOLOGICAL SOURCE	CHEMICAL CONSTITUENTS
1.	*Piper longum*	β-caryophyllene, piperine, pipernonaline, piperundecalidine, piperlatine, sesamine,dihydriostifransterol, piplasterol and futoamide
2.	*Piper nigrum*	Chavicine, piperine, piperidine, piperitine, pipercide, isochavinic acid
3.	*Zingiberofficinale*	Gingerols, shogaols, gingerdione
4.	*Cuminumcyminum*	Cuminaldehyde**,** cuminin,1,3 - þ - menthadien -7-a, glycosides of luteolin and apigenin
5.	*Nigella sativa*	Nigellinine- N-oxide, nigellicine, arenasterol-5-ene, lophenol, α-hederin and fatty acids.
6.	*Trachyspermumammi*	Tannin, Glycosidre, Pinene, Dipentenes
7.	*Hyoscyamusniger*	Hyoscyamine, hyoscine, isomeric N-oxides of hyoscyamine (equatorial and axial)
8.	*Alpiniagalanga*	Esential oil, containing a - pinene, ß - pinene, limonene, cineol, linalool, cedrol, eugenol
9.	*Alpiniaofficinarum*	48% of methyl cinnamate, 25% of cineole, camphor, pinene
10.	*Terminalliachebula*	Gallic acid, chebupentol, terchebin, ellagitannin, arjungenin, arjunolic acid
11.	*Phyllanthusemblica*	Ascorbic, tannins, gallic, ellagic, phyllemblic acid and emblicol
12.	*Terminalia belerica*	Gallic acid, ellagic acid, ethyl gallate, galloyl glucose and chebullagic acid, belleric acid
13.	*Syzygiumaromaticum*	Caryophyllene oxide, caryophylla -3 (12), 6-dien-4-ol ,caryophylla -3 (12)
14.	*Cinnamomumverum*	Cinnacassiol A, B and C, trans-cinnamic acid, protocatechuic acid, cinnamaldehyde and eugenol

15.	*Taxuswallichiana*	0.04% of Paclitaxel
16.	*Plumbagozeylanica*	Plumbagin, 3-chloroplumbagin, 3, 3- biplumbagin
17.	*Eletteriacardamonum*	Cineole, terpinyl acetate, terpineol, borneol
18.	*Cinnamommumtamala*	linalool, caryophyllene oxide, d -β- phellandrene, eugenol
19.	Ghee	99-99.5% lipids from which 46-47.8% is saturated fat, 36% monounsaturated and 18% polyunsaturated
20.	Honey	Fructose, Glucose, Sucrose

Table 6: Medicinal uses of each individual herbal drugsof Thippili Rasayanam [7, 38-45]

S.NO	BIOLOGICAL SOURCE	THERAPEUTIC USES
1.	*Piper longum*	Cough, Breathing.
2.	*Piper nigrum*	Fever, cough
3.	*Zingiber officinale*	Cough, Breathing, Headache, Asthma
4.	*Cuminum cyminum*	Cirrhosis, Dyspepsia
5.	*Nigella sativa*	Bronchitis, Asthma
6.	*Trachyspermum ammi*	Asthma, Typhoid fever
7.	*Hyoscyamus niger*	Cough, Asthma
8.	*Alpinia galanga*	Body pain, Dyspepsia, Fever
9.	*Alpinia officinarum*	Chest pain, Fever
10.	*Terminalliac hebula*	Chronic cough, Asthma, Sore throat
11.	*Phyllanthus emblica*	Cough, Asthma
12.	*Terminalia belerica*	Cough, Bronchitis
13.	*Syzygium aromaticum*	Vomiting, Flatulence
14.	*Cinnamomum verum*	Breathing, Dyspepsia
15.	*Taxus wallichiana*	Cough, Cold, Indigestion
16.	*Plumbago zeylanica*	Chronic cold, Cough
17.	*Eletteria cardamonum*	Nausea, Vomiting
18.	*Cinnamommum tamala*	Cough, Cold, Sore throat
19.	Ghee	Reduces inflammation, Boosts energy
20.	Honey	Cough, Chronic bronchitis

Piper longum

Piper nigrum

Zingiber officinale

		
Cuminum cyminum	***Nigella sativa***	***Trachyspermum ammi***
		
Hyoscyamus niger	***Alpinia galanga***	***Alpinia officinarum***
		
Terminalliac hebula	***Phyllanthus emblica***	***Terminalia belerica***
		
Syzygium aromaticum	***Cinnamomum verum***	***Taxus wallichiana***

		
Plumbago zeylanica	***Eletteria cardamonum***	***Cinnamommum tamala***
		
Ghee	**Honey**	

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RESEARCH ARTICLE

Independent Domination Number and Chromatic Number of a Rough Co-zero Divisor Graph

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ABSTRACT

In this article we focus on determining the Maximum degree, Independent domination number and Chromatic number of a Rough Co-zero divisor Graph $G(Z^*(J))$ corresponding to a Rough semiring (T, Δ, ∇).The methodology of these graph theoretical parameters are computed using partition graph $P(Z^*(J))$ of a Rough co-zero divisor graph $G(Z^*(J))$. The complexity of this computation is made simpler using $P(Z^*(J))$that leads us to prove that the Maximum degree of $G(Z^*(J))$ as $2^{n-m}.3^m - 3$ if $n \neq m$ and $2^{n-m}.3^m - 4$ if $n = m$ and Independent domination number of $G(Z^*(J))$ is 2 for $1 \leq m \leq n$ and the Chromatic number of $G(Z^*(J))$ is equal to the Clique number of $G(Z^*(J))$. We also provided the relevant examples to demonstrate the defined approach.

AMS Classification 05C69, 05B10, 05C07, 05A18

Keywords: Maximum degree, Independence number, Domination number, Chromatic number, Rough Co-zero divisor graph, Partition graph.

INTRODUCTION

Rough set theory is an optimistic technique for knowledge discovery and data mining from databases and it is proposed by Pawlak [9] in 1982. He defined Rough set as a formal approximation of a crisp set in terms of a pair of sets which give the lower and the upper approximations of the original set. Rough set theory is an extension of Fuzzy set theory. Rough sets have been proposed for a very wide range of applications. In Artificial Intelligence, machine learning, expert systems, data mining, pattern recognition, approximate reasoning, and other fields, the rough set approach is especially useful. The concept of Rough Lattice was discussed by B. Praba and R .Mohan [4-8] In this paper, the authors considered an information system and for any given information system a relation R on the set of all Rough sets T was defined and also the authors discovered two operations called $Praba\Delta$ and $Praba\nabla$ using these two operations the authors proved that (T, Δ, ∇) is a semiring called as a rough semiring.

The goal of this paper is to find the Maximum degree, Independence domination number, and Chromatic number of a Rough Co-zero divisor graph. This paper is divided into the following sections:
In Sec. 2, we present the fundamental definitions for the understanding of the article
In Sec. 3, we acquire the Maximum degree, Independence domination number and Chromatic number of a Rough Co-zero divisor graph and we illustrate with appropriate examples.
In Sec. 4, we give the conclusion.

Preliminaries

2.1 Rough Set Theory

In this section we consider an approximation space $I = (U, R)$ where U is a non empty finite set of objects, called universal set and R be an equivalence relation defined on U.

Definition 2.1.1

For any approximation space, the equivalence classes induced by R is defined by $[x] = \{y \in U \mid (x, y) \in R\}$. For any $X \subseteq U$, the lower approximation is defined as $R\_(X) = \{x \in U \mid [x] \subseteq X\}$ and the upper approximation is defined by $R^{-}(X) = \{x \in U \mid [x] \cap X = \phi\}$. The rough set corresponding to X is $RS(X) = (R\_(X), R^{-}(X))$.

Theorem 2.1.1

For any approximation space $I = (U, R)$, (T, Δ, ∇) is a semiring called the Rough semiring.

2.2 Rough Co-zero divisor Graph

In this section we consider an approximation space $I = (U, R)$ where U is the non empty finite set of objects and R is an equivalence relation on U. Let (T, Δ, ∇) be the rough semiring induced by I. Without loss of generality we also assume that there are m equivalence classes $\{X_1, X_2, \ldots X_m\}$ with cardinality greater than 1 and the remaining $n - m$ equivalence classes $\{X_{m+1}, X_{m+2}, \ldots X_n\}$ have cardinality equal to 1, where $1 < m \leq n$. Let B be the set of representative elements of $X_i, i = 1, 2, \ldots, m$ and J be the rough ideal of T. We also assume that M is the union of none, one or more equivalence classes whose cardinality is equal to one and M' is the union of one or more equivalence classes whose cardinality is equal to one.

Definition 2.2.1

Rough Co-zero divisor graph The Rough Co-zero divisor graph $G(Z^*(J)) = (V, E)$ where V is the set of vertices consisting of the elements of $T^* = T - \{RS(\emptyset), RS(U)\}$ and two elements $RS(X), RS(Y) \in T^*$ are adjacent iff $RS(X) \notin RS(Y)\nabla J$ and $RS(Y) \notin RS(X)\nabla J$.

2.3 Partition Graph

Partition graph $P(Z^*(J))$ is obtained by defining suitable partition in the vertices of $G(Z^*(J))$. Hence vertices having same degree will fall into same partition.

Definition 2.3.1

Partition graph The partition graph $P(Z^*(J))$ is a graph whose vertices are the partitions on $V(Z^*(J))$ Hence the vertices of $P(Z^*(J))$ is the set $\{P_1, P_2, P_3, P_4, P_5, P_6, P_7\}$ where

$P_1 = RS(x_i)$
$P_2 = RS(x_i \cup M') \cup RS(X_i \cup M)$
$P_3 = RS(Y) | Y \in M'$
$P_4 = RS(x_1, x_2, \ldots x_r)$
$P_5 = RS(x_1, x_2, \ldots x_m)$
$P_6 = RS\, x_1, x_2, \ldots x_r \cup M' \cup RS(X_1, X_2, \ldots X_r \cup M) \cup RS(Q_r \cup M)$
$P_7 = RS\, x_1, x_2, \ldots x_m \cup M' \cup RS(X_1, X_2, \ldots X_m \cup M) \cup RS(Q_m \cup M)$

Two vertices P_i and P_j in the partition graph are connected by an edge if the elements in P_i are adjacent to any of the elements in P_j by an edge in $G(Z^*(J))$.
The following Figure 1 represents the partition graph of $G(Z^*(J))$ for $n \neq m$
When $n = m$, the corresponding partition graph of $G(Z^*(J))$ is given in Figure 2

Theorem 2.3.1
The degree of $RS(x_i)$ is $(m-1)(2^{n+1-m}) + 2^{m-1} - m + 2^{n-m} - 1 + [(m-1)C_r(2^{n-m}-1) + (m-1)C_r(2^{n-m}) + \sum_{r=2}^{m-1}((m-1)C_1 + (m-1)C_2 + \cdots + (m-1)C_{r-1})](2^{n-m})$
Theorem 2.3.2
The degree of $RS(x_i \cup M') \cup RS(X_i \cup M)$is $m(2^{n+1-m}-1) + 2^m - m - 2 + 2^{n-m} - 1 + 1 + 2^m - (m+2)(2^{n-m+1} - 1) + 3(3^{m-1} - 2^m + 1)(2^{n-m}) + 2^{n-m}(2^m) - 2$
Theorem 2.3.3
The degree of the elements in the set $\{RS(Y)|Y \in M'\}$ for $i = 1,2,..m$ is $(2^m + 1)2^{n-m} - (m+2)(2^{n+1-m}-1) + 2^m - m - 2 + 2^m + 3(2^{n-m})(3^{m-1} - 2^m + 1) + 2^{n-m}(2^m) - 2$
Theorem 2.3.4
The degree of elements in $RS(x_1, x_2 \ldots x_r)$ is $2^{n-m}(2^m) - 2^{m-1} - 2 + \left\{\left(\frac{m(m-1)}{2} - 1\right) + \left(\frac{m(m-1)(m-2)}{2} - 1.2 + 2.3 + \cdots (m-2)(m-1)\right) + \cdots + 1 - 2 + (|A| - (* + ** + ***))\right\}$
Where $|A| = 2^{n-m}(2^m) - 2$
$* = \left\{\left[\frac{m(m-1)}{2}\right].[(m-2)C_0 + (m-2)C_1 + \cdots + (m-2)C_{m-3}] + \left[\frac{m(m-1)(m-2)}{2} - 1.2 + 2.3 + \cdots (m-2)(m-1)\right].[(m-3)C_0 + (m-3)C_1 + \cdots + (m-3)C_{m-4}] + \cdots + 1.\left[m(m(m-1)).(2^{n-m}-1)\right]\right\}$
$** = \left\{\left[\frac{m(m-1)}{2}\right].[(m-2)C_0 + (m-2)C_1 + \cdots + (m-2)C_{m-3}] + \left[\frac{m(m-1)(m-2)}{2} - 1.2 + 2.3 + \cdots (m-2)(m-1)\right].[(m-3)C_0 + (m-3)C_1 + \cdots + (m-3)C_{m-4}] + \cdots + 1.\left[m(m(m-1)).(2^{n-m})\right]\right\}$
$*** = \left\{\left[\frac{m(m-1)}{2}\right]\left[\sum_{k=2}^{m-1}\sum_{i=1}^{k-1} kC_i\right] + \left[\frac{m(m-1)(m-2)}{2} - 1.2 + 2.3 + \cdots (m-2)(m-1)\right] + \left[\sum_{k=3}^{m-1}\sum_{i=1}^{k-1} kC_i\right] + .. + 1\right\} 2^{n-m}$
Theorem 2.3.5
The degree of $RS(x_1, x_2, \ldots x_m)$ is $2^{n-m}[2m + 2^m - (m+2) + 3(3^{m-1} - 2^m + 1)] - m$
Theorem 2.3.6
The degree of $\{RS(x_1, x_2, \ldots x_r \cup M')|1 < r < m\}$ is $2^{n-m}[2m + 2^m + 1 + 3(3^{m-1} - 2^m + 1)] + [2^m - (m+2)](2^{n-m+1} - 1) - 8$
Corollary 2.3.1
The degree of $\{RS(X_1, X_2, \ldots X_r \cup M)|1 < r < m\}$ is $2^{n-m}[2m + 2^m + 1 + 3(3^{m-1} - 2^m + 1)] + [2^m - (m+2)](2^{n-m+1} - 1) - 8$
Corollary 2.3.2
The degree of $RS(Q_r \cup M)$ is $2^{n-m}[2m + 2^m + 1 + 3(3^{m-1} - 2^m + 1)] + [2^m - (m+2)](2^{n-m+1} - 1) - 8$
Theorem 2.3.7
The degree of $RS(x_1, x_2, \ldots x_m \cup M')$ is $2^{n-m}[2^{m+1} + m - 2 + 3(3^{m-1} - 2^m + 1)] - (m+3)$
Corollary 2.3.3
The degree of $RS(X_1, X_2, \ldots X_m \cup M)$is $2^{n-m}[2^{m+1} + m - 2 + 3(3^{m-1} - 2^m + 1)] - (m+3)$
Corollary 2.3.4
The degree of $RS(Q_m \cup M)$is $2^{n-m}[2^{m+1} + m - 2 + 3(3^{m-1} - 2^m + 1)] - (m+3)$

Maximum Degree, Independent Domination Number and Chromatic Number of a Rough Co-Zero Divisor Graph

Aim of this section is to obtain the Maximum degree, Independent domination number and Chromatic Number of a Rough Co-zero Divisor Graph using partition graph.

3.1 Maximum Degree of a Rough Co-zero divisor graph

In this section Maximum Degree of a Rough Co-zero divisor graph is obtained.

Definition 3.1.1

Degree of a vertex in $G(Z^*(J))$ is denoted by $deg(RS(X))$, is the number of edges incident with $RS(X)$. The maximum degree of $G(Z^*(J))$ denoted by $\Delta(G(Z^*(J))$, is defined to be

$$\Delta(G(Z^*(J))) = max\{\deg(RS(X)|RS(X) \in V(Z^*(J))\}$$

Theorem 3.1.1

$\Delta(G(Z^*(J))) = \begin{cases} 2^{n-m}.3^m - 3 \text{ when } n \neq m \\ 2^{n-m}.3^m - 4 \; when \; n = m \end{cases}$

Proof:

Let us consider the Rough Co-zero divisor graph $G(Z^*(J))$ and let $P(Z^*(J))$ be the partition graph corresponding to $G(Z^*(J))$. The degree of each of the vertex in the partition graph is given in Theorem 2.1-2.7 [7]. Now let us consider the following two cases.

Case1: When $n \neq m$

From the partition graph $P(Z^*(J))$, consider any of the vertex in P_3 say $RS(X_{m+1})$. It is obvious to check that $RS(X_{m+1})$ is connected to every other vertex in $G(Z^*(J))$ and hence $\deg(RS(X_{m+1})) = \Delta(G(Z^*(J))) = 2^{n-m}.3^m - 3$

Case2: When $n = m$

Note that when = m , $P_3 = \emptyset$. Let us consider any element in P_2 say $RS(X_1)$.

As it is known that $P_2 = \{RS(x_i \cup M') \cup RS(X_i \cup M)|i = 1,2..m\}$

For each i, $RS(x_i \cup M') \cup RS(X_i \cup M)$ will not connected to $RS(x_i)$ as $RS(x_i) \in RS(x_i \cup M')\Delta J$ & $RS(x_i) \in RS(X_i \cup M')\Delta J$ and also $i = 1,2,\dots m$, $RS(x_i \cup M')$ is connected to all $RS(x_i \cup M') \cup RS(X_i \cup M)$ and $RS(X_i \cup M)$ is connected to all $RS(x_i \cup M') \cup RS(X_i \cup M)$. Therefore the total sum of such elements to which $RS(x_i \cup M') \cup RS(X_i \cup M)$ connected to is $(2^{n-m+1} - 1)$.Evidently $RS(x_i \cup M') \cup RS(X_i \cup M)$ is connected to all the elements of the set $\{RS(Q_j)|Q_j \in P(Q) - \emptyset, Q = X_{m+1}, X_{m+2,\dots}X_n\}$. Number of such elements to which $RS(x_i \cup M') \cup RS(X_i \cup M)$ connected to is $2^{n-m} - 1$.

For each i, every elements in $RS(x_i \cup M') \cup RS(X_i \cup M)$is connected to the set $\{RS(x_1, x_2 \dots x_r)|1 < r < m\}$. Number of such elements is given by $2^m - m - 2$. Similarly for each i, the set P_2 is connected to the single element set $RS(x_1, x_2 \dots x_m)$. Hence the number of such element is 1. For $i = 1,2,\dots m$, every elements in P_2 is connected to the set $RS(x_1, x_2 \dots x_r \cup M')$ with $(2^m - (m + 2))(2^{n-m})$ elements and P_2 is connected to the set $RS(X_1, X_2 \dots X_r \cup M)$ with $(2^m - (m + 2))(2^{n-m} - 1)$ elements and P_2 is connected to the set $RS(Q_r \cup M)$ where $Q_r = x_r$ or X_r with $3(2^{n-m})(3^{m-1} - 2^m + 1)$ elements.

The same as $i = 1,2,\dots m$, every elements in P_2 is connected all the elements in the set $RS(x_1, x_2 \dots x_m \cup M') \cup RS(X_1, X_2 \dots X_m \cup M) \cup RS(Q_m \cup M)$with $2^{n-m}(2^m) - 2$ elements

Hence vertex $RS(X_1)$ is connected to all the other vertices in $G(Z^*(J))$ except $RS(x_1)$. Therefore $\deg(RS(X_1)) = \Delta(G(Z^*(J))) = 2^{n-m}.3^m - 4$.

The following example will provide a clear understanding of the preceding concept.

Example 3.1.1

Let $U = \{x_1, x_2, x_3, x_4, x_5, x_6\}$ and let $\{X_1, X_2, X_3\}$ are the equivalence classes induced by an equivalence relation R on U such $X_1 = \{x_1, x_3\}$, $X_2 = \{x_2, x_4, x_6\}$ and $X_3 = \{x_5\}$

$V(Z^*(J)) = \{RS(x_1), RS(x_2), RS(X_1), RS(X_2), RS(X_3), RS(x_1 \cup x_2), RS(X_1 \cup X_2), RS(X_1 \cup X_3), RS(X_2 \cup X_3), RS(x_1 \cup X_2), RS(X_1 \cup x_2), RS(x_1 \cup X_3), RS(x_2 \cup X_3), RS(x_1 \cup X_2 \cup X_3), RS(X_1 \cup x_2 \cup X_3), RS(x_1 \cup x_2 \cup X_3)\}$; $B = \{x_1, x_2\}$, $J = \{RS(x_1), RS(x_2), RS(x_1 \cup x_2)\}$

Figure 3 represents the Rough co-zero divisor graph for $n = 3$ and $m = 2$.

$\deg(RS(X_{m+1})) = \Delta(G(Z^*(J))) = 15$ for $n \neq m$

Example 3.1.2

Let $U = \{x_1, x_2, x_3, x_4, x_5, x_6\}$ and let $\{X_1, X_2, X_3\}$ are the equivalence classes induced by an equivalence relation R on U such $X_1 = \{x_1, x_3\}$, $X_2 = \{x_2, x_4\}$ and $X_3 = \{x_5, x_6\}$

$V(Z^*(J)) = \{RS(x_1), RS(x_2), RS(x_3), RS(X_1), RS(X_2), RS(X_3), RS(x_1 \cup x_2), RS(x_1 \cup x_3), RS(x_2 \cup x_3), RS(x_1 \cup x_2 \cup x_3), RS(X_1 \cup X_2), RS(X_1 \cup X_3), RS(X_2 \cup X_3), RS(x_1 \cup X_2), RS(X_1 \cup x_2), RS(x_1 \cup X_3), RS(X_1 \cup x_3), RS(x_2 \cup X_3), RS(X_2 \cup x_3), RS(x_1 \cup X_2 \cup X_3), RS(X_1 \cup x_2 \cup X_3), RS(X_1 \cup X_2 \cup x_3), RS(x_1 \cup x_2 \cup X_3), RS(x_1 \cup X_2 \cup x_3), RS(X_1 \cup x_2 \cup x_3)\}$
$B = \{x_1, x_2, x_3\}, J = \{RS(x_1), RS(x_2), RS(x_3), RS(x_1 \cup x_2), RS(x_1 \cup x_3), RS(x_2 \cup x_3) RS(x_1 \cup x_2 \cup x_3)\}$
Figure 4 represents the Rough co-zero divisor graph for = m = 3.

3.2 Independent domination number of a Rough Co-zero divisor graph

In this section the Independent domination number of a Rough Co-zero divisor graph is derived.

Definition 3.2.1

An independent dominating set of a Rough Co-zero divisor graph $G(Z^*(J))$ is a subset $ID(G(Z^*(J))$ of $V(Z^*(J))$, such that every vertex not in $ID(G(Z^*(J))$is adjacent to at least one vertex in $ID(G(Z^*(J))$and no two vertices in $ID(G(Z^*(J))$are adjacent. The independent domination number of $G(Z^*(J))$ is the minimum cardinality of an independent dominating set of $G(Z^*(J))$.

Theorem 3.2.1

Independent domination number of a Rough Co-zero divisor graph
$ID(G(Z^*(J))$ = 2 for $1 \leq m \leq n$

Proof

Let $ID(G(Z^*(J)) = \{RS(x_1), RS(X_1)\}$ and now let us prove that $ID(G(Z^*(J))$ is the independent dominating set.
Consider $RS(Y) \in G(Z^*(J))$, now it is sufficient to prove that $RS(Y)$ is adjacent to either $RS(x_1)$ or $RS(X_1)$. Note that the element $RS(X_1)$ in P_2 is adjacent to all the elements except $RS(x_1)$ and also $RS(x_1) \in RS(X_1) \nabla J$ which implies there is no edge between $RS(x_1)$ and $RS(X_1)$.
Hence $ID(G(Z^*(J)) = \{RS(x_1), RS(X_1)\}$ forms a independent dominating set of $G(Z^*(J))$ and independent domination number is 2 for $1 \leq m \leq n$.

Example 3.2.1 (From example 3.1.1)

For n = 3 and m = 2.
$ID(G(Z^*(J)) = \{RS(x_1), RS(X_1)\}$ and $|ID(G(Z^*(J))| = 2$

Example 3.2.2 (From example 3.1.2)

For n = 3 and m = 3.
$ID(G(Z^*(J)) = \{RS(x_1), RS(X_1)\}$ and $|ID(G(Z^*(J))| = 2$

3.3 Chromatic number of a Rough Co-zero divisor graph

In this section the Chromatic number of a Rough Co-zero divisor graph is obtained.

Definition 3.3.1

The Chromatic number of a Rough Co-zero divisor graph, is the smallest number of colours needed to colour $V(Z^*(J))$ such that no two connected vertices in $G(Z^*(J))$ share the same colour and Chromatic number of $G(Z^*(J))$ is denoted by $\chi(G(Z^*(J)))$.

Theorem 3.3.1:

In $G(Z^*(J))$, $\chi\left(G(Z^*(J))\right) = \omega\left(G(Z^*(J))\right) = 2^{n-m}.3^m - 2^m - 1$ for $1 \leq m \leq n$.

Proof:

By Theorem 3.1[8] the Clique number of $G(Z^*(J))$ is $2^{n-m}.3^m - 2^m - 1$.
Now we claim that this $2^{n-m}.3^m - 2^m - 1$ is also equal to the Chromatic number of $G(Z^*(J))$. It is observed that the elements of P_2, P_3, P_6 and P_7 forms a maximal complete subgraph of $G(Z^*(J))$ which is equal to $2^{n-m}.3^m - 2^m - 1$. Hence we use $2^{n-m}.3^m - 2^m - 1$ colours to colour the vertices of this maximal complete subgraph. Now it is enough to prove that these colours are sufficient to colour the remaining vertices namely the elements of P_1, P_4 and P_5. Note that elements of P_7 are not connected to P_1, P_4 and P_5 also P_5 contains only one element. As well note that the total number of vertices in P_1 and P_4 is $2^m - 2$ and the number of vertices in P_7 is $2^n - 2$.

For $1 \leq m \leq n$, $2^m - 2 \leq 2^n - 2$. Hence the $2^n - 2$ colours that we used to colour the vertices of P_7 can be used to colour the vertices of P_1 and P_4. As the only vertex in P_5 is not connected to any of the vertices in P_1 or P_7. Therefore any colour that are used to colour the elements of P_1 can be used to colour the vertex in P_5. Hence the Chromatic number $\chi\left(G\left(Z^*(J)\right)\right)$ of $G(Z^*(J))$ is $2^{n-m}.3^m - 2^m - 1$.

Example 3.3.1 (From example 3.1.1)

For $n = 3$ and $m = 2$.

By theorem 3.1 [8] and by the above theorem it is clear that

$\chi\left(G\left(Z^*(J)\right)\right) = 13 = \omega\left(G\left(Z^*(J)\right)\right)$

Example 3.3.2 (From example 3.1.2)

For $n = 3$ and $m = 3$.

$Gr(G(Z^*(J))) = \{RS(X_1), RS(X_2), RS(X_1x_2)\}$

By theorem 3.1[8] and by the above theorem it is obvious that

$\chi\left(G\left(Z^*(J)\right)\right) = 18 = \omega\left(G\left(Z^*(J)\right)\right)$

CONCLUSION

In this article, the Maximum degree, Independent domination number and Chromatic number of the Rough Co-zero divisor Graph $G(Z^*(J))$ are determined using partition graph $P(Z^*(J))$ are obtained. All of the concepts are established with relevant examples. Future contribution is to obtain some potential applications of these graph theoretical parameters.

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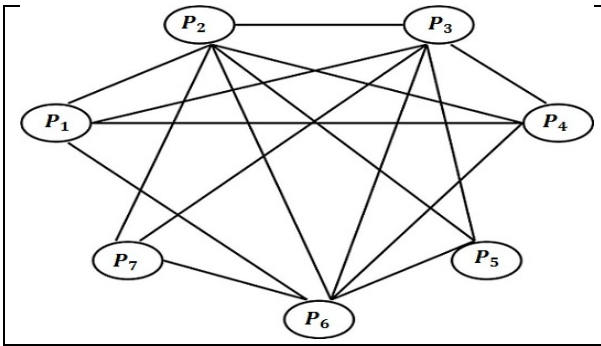


Figure 1: Partition Graph for $n \neq m$

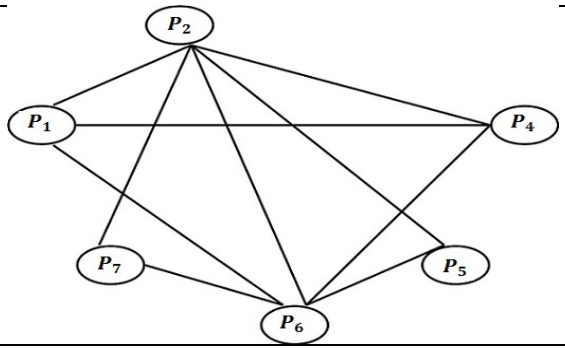


Figure 2: Partition Graph for $n = m$ Partitions and Cardinalities of $G(Z^*(J))$

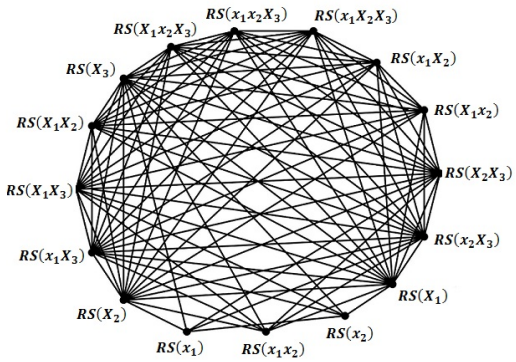


Figure 3: Rough co-zero divisor graph for $n = 3$ and $m = 2$.

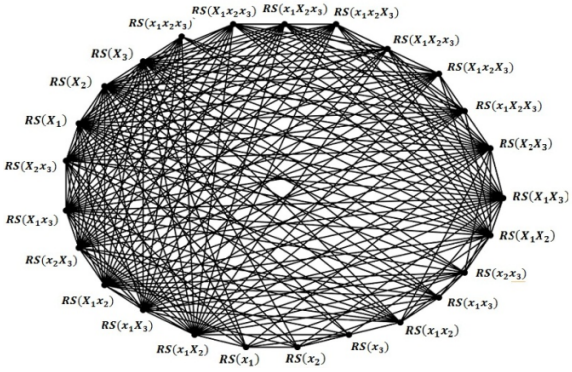
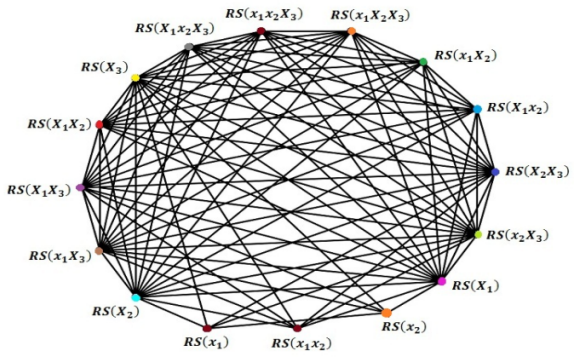
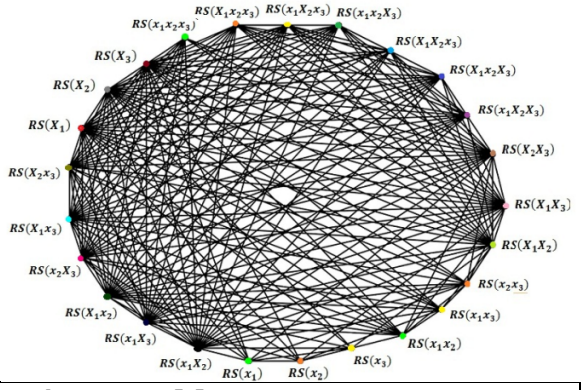


Figure 4: Rough co-zero divisor graph for $n = m = 3$



By theorem 3.1 [8]

$\chi\left(G(Z^*(J))\right) = 13 = \omega\left(G(Z^*(J))\right)$



By theorem 3.1[8]

$\chi\left(G(Z^*(J))\right) = 18 = \omega\left(G(Z^*(J))\right)$

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REVIEW ARTICLE

A Comprehensive Review on *Abutilon hirtum* (lamp) Sweet.

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ABSTRACT

Medicinal plants constitute the "backbone" of traditional medicine, which means that over 3.3 billion people in developing nations use them on a daily basis. These medicinal plants are thought to be a rich source of components for medication discovery and synthesis. A number of herbs belonging to the species *Abutilon* are noted for their medicinal benefits in traditional system of medicine. A lot of medicinally important attributes have been assigned to the plants of this species. Large number of reports on *Abutilon* spp. indicates continuous scientific research on it with special reference to their medicinal cultivation and biotechnological applications. *Abutilon hirtum* (Lamp) Sweet is one of the species of abutilon, commonly known as Vadathuthi. Traditionally, it was reported for its anti-inflammatory, demulcent, diuretic, ulcer and diarrhea. In this connection, the present review aims at exploring current scientific findings on the *Abutilon hirtum* (Lamp) Sweet.

Keywords: *Abutilon hirtum,* Medicinal plants, Phytoconstituents, Pharmacological activity.

INTRODUCTION

In almost all cultures, medicinal plants are essential components of traditional medicine. For medicinal purposes, various plant components such as bulbs, leaves, roots, barks, peels, seeds, flowers are used. Around 80% of the population of developed countries depends on traditional medicine, which consists of the active compounds derived from medicinal plants, according to the World Health Organization [1]. The plant kingdom has proved to be an enormous reservoir of biologically active compounds with various properties that resist chemical structures and diseases [2]. Many herbs belonging to the specie Abutilon are documented for their various medicinal benefits. The genus *Abutilon* is a large group of flowering plants belongs to the family malvaceae with over 200 species occurring throughout the tropics and subtropics. Also, the plants from Abutilon spp. are claimed for other medicinal properties

for the treatment of different disorders, but still they are not satisfactorily exploited. Hence, the present review aims at exploring current scientific findings on the *Abutilon hirtum* (Lamp) Sweet.

Description

Abutilon hirtum is a perennial herb or shrub. The leaves are Simple, petiolate, alternating, cordate with acuminate apex, delicate serrate edge and symmetric base, green in color with top surface darker than lower surface, hairy surface, coriaceous texture, faint aroma and mucilaginous taste, palmately reticulate venation, palmately reticulate venation On the ground level, the midrib is more apparent. The leaves are 11-13 centimeters long and 8-10 centimeters wide. The petiole is cylindrical, green in color, and has a hairy surface. It is 1.5–22 cm long and 0.1–0.6 cm wide. The stem is tall, cylindrical, and green in color, with monopodial branching with internodes ranging in length from 0.5 to 7 cm. The pedicel is cylindrical, green, and hairy, with a length of 0.4-0.8 cm and a diameter of 0.1-0.2 cm. The calyx, which is made up of five sepals that are joined together, is permanent. The sepals are lanceolate in shape, with an acute apex, hairy surfaces, and valvate aestivation. The calyx is 1.1-1.7 cm long and 0.8-1 cm wide. The leaves, stem and flowers of *Abutilon hirtum* were shown in fig. no.1. In Kenya, the leaves or blooms are used to cure abscesses, while the roots are utilized as an expectorant, analgesic, and antipyretic. The fruits are also consumed raw, and a water extract of the bark is used to aid with childbirth [3].The taxonomical classification and vernacular names of *Abutilon hirtum* were given in table 1 and 2.

Distribution

Abutilon species is an evergreen Shrub growing to 3 m. It is in leaf all year and in flower from April to September. The species is hermaphrodite (has both male and female organs) grows well in sandy, loamy and clay soils. Suitable pH: acid, neutral and basic (alkaline) soils. It can grow in semi-shade (light woodland) or no shade. It prefers moist soil. It is distributed in tropical and subtropical countries of America, Africa, Asia and Australia. In India, it is widely distributed in Tamilnadu and Andrapradesh [7].

Phytoconstituents

The roots of the plant showed the presence of alkaloids [8,9]. The methanol leaf extract of *Abutilon hirtum* contained alkaloids, flavonoids, saponins, cardiac glycoside, terpenes and steroids, phenols, and resins, but balsam was not present. It was reported that the chloroform leaf extracts contain the largest percentage content of benzaldehyde 4-propyl (5.219%), methoxyacetic acid 3-tridecyl ester (5.196%), 2,5-Octadecadiynoic acid methyl ester (2.782%), and sulfurous acid dodecyl 2-propyl ester (0.455 %) [10].

Traditional uses

The leaves have traditionally been used as a demulcent, diuretic, and diarrhea remedy. The leaves' decoction is used as a mouthwash, to treat bladder inflammations, wounds, and ulcers [11,12,13].

Pharmacological Studies

The various plants of the Abutilon spp., because of their different phytochemicals, possesses different pharmacological activities and hence used for the treatment of associated disorders. *Abutilon hirtum* has been reported for the following pharmacological activity such as anti-inflammatory activity, analgesic activity, antipyretic activity and anti-diabetic activity [14], Hepatoprotective activity [15], anti-oxidant and anti-cancer activity [16], and *In-vitro* cytotoxic activity [17].

CONCLUSION

The phytochemical research found alkaloids, flavonoids, saponins, cardiac glycoside, sterpenes and steroids, phenols, and resins. As a result, the presence of a wide range of chemical compounds could imply that the active ingredients separated from the species could serve as a "lead" for the creation of novel drugs that are effective in a

variety of clinical conditions. Only a few works were mentioned. Scientific validation of this plant could lead to the creation of innovative medications with a broad spectrum of activity for the treatment of a variety of diseases in the future.

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Table 1: Taxonomical classification of *Abutilon hirtum*

***Abutilon hirtum*(Lamp) Sweet**	
Kingdom	Plantae
Division	Tracheophyta
Class	Magnoliopsida
Superorder	Rosanae
Order	Malvales
Family	Malvaceae.[4,5,6]

Table 2: Vernacular name of *Abutilon hirtum*

***Abutilon hirtum*(Lamp) Sweet**	
Common name	**Hairy Indian Mallow, Indian mallow**
Tamil	Vadattuti
Hindi	Bankhanghi
Marathi	Bankhanghi
Telugu	Pala benda, Nelabenda
Kannada	Tutti

Fig: Leaves, stem and Flowers of *Abutilon hirtum*

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RESEARCH ARTICLE

Factors Influencing the Seasonal Distribution and Species Richness of Cyanobacteria, A Study of Tiruchirappalli Fresh Water Habitats, India

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ABSTRACT

Cyanobacteria, in oblivion, uncared for and unrecognized, have shot into fame and popularity owing to a host of their innate properties that build them ideal organisms for use in a variety of ways to meet our desires and to assure us a bright future. Besides their ecological significance, they offer a great potential tool as organisms for biotechnological interest such as mariculture, food, feed, fuel, fertilizer, medicine and combating pollution. Primary production is an important biological phenomenon in the aquatic environment in which phytoplankton act as a primary producer. Their physiological activities greatly controlled by physico-chemical characters of the water body.This study highlighted the tremendous inter and intraspecific diversity within the freshwater habitats of Tiruchirappalli District.

Keywords: Cyanobacteria, fresh water, physico-chemical parameters, biodiversity, Tiruchirappalli.

INTRODUCTION

Cyanobacteria (blue-green algae) are capable of both carbon assimilation and N_2Fixation, thereby enhancing farming productivity in a variety of environments. Tropical conditions such as those in India provide a favorable environment for the luxuriant growth of these organisms in a variety of natural ecosystems such as different types ofsoil, freshwater bodies, oceans, saline backwaters, estuaries, and also hypersaline salt pans [Thjuddin N, Nagasathya A, Chelladevi R., Saravannan L];[Rajakumar, N]; [Chellapa SL, and Chellapa NT.] [1,2,3]. Distribution of these organisms in diverse habitats has attracted the attention of scientists for evolving proper methods for their ecological examinations. Cyanobacteria have a significant set of attributes and strategies, which make it possible for them to colonize and survive under extreme habitats. These organisms are able to interact with their niche, develop certain survival mechanisms and either exploit or modify their attributes to make them more suitable under water

stress conditions. A host of issues that have an effect on the distribution of cyanobacteria include pH, soil moisture, mineral nutrients and combined nitrogen [Tiwari ON, Singh, BV, Upasana M, Singh AK, Dolly Wattal D,& Singh PK] [4]. Cyanobacteria commonly produce heavy growth, termed blooms in natural and man-made bodies of water. The bloom-forming blue-green algae can form thick scums, especially around the margins of lakes and reservoirs. It is notable that the toxin-forming blue-green algal species often predominate in these surface scums [Shrivastava, A.K] [5]. In the recent years, the interest in the study of cyanobacteria as sources of bioactive compounds has increased. The cyanocbacterial bioactive compounds play important role has antibacterial **[**Bouhlal, R., Riadi, H., and Bourgougnon, N**] [6],** antiviral, antifungal, anti-allergic anticoagulant, anticancer, antifouling [Bhadury, P., and Wright, C.P] [7] antimalarial, year and antioxidant activities [Devi, G.K. Manivannan, K. Thirumaran, G. Rajathi, F.A.A., Anantharaman, P] [8]. Mostly, extracts of marine algae were reported to exhibit antibacterial activity. In general, isolation of bioactive compounds from cyanobacteria is done to discover new compounds for pharmaceutical, agricultural or bio control application. The important compounds identified as antimicrobials are fatty acids, acrylic acid, halogenated aliphatic compounds, terpenes, sulphur containing hetero cyclic compounds, carbohydrates and phenols [Kannan, R.R.R., Arumugam, R., Anantharaman, PP] [9]. Many marine natural products possess novel functional groups and molecular structures compared to those from terrestrial sources. Over, 21,800 natural products have been described from marine organisms.

Cyanobacteria are known to produce secondary metabolites and pharmacologically valuable compounds in different countries but such reports from India are scarce. Several reports focused on particular area and there is no report in diversity of Tiruchirappalli and various districts. Hence, the present study aimed to isolate and characterize the biodiversity of fresh water cyanobacteria including fresh water lake, pond, rice fields and Cauvery River of in and around Tiruchirappalli District.

MATERIALS AND METHODS

Study Area

The sampling site for this study was Tiruchirappalli, which is located at the geographic center of the state of Tamil Nadu, India. The city spread over an area of167. 25 square kilometers (64.6 sq mi) and is situated on the plains between the Shevaroy Hills to the north and the Palni Hills to the south and south-west. The city isolated at the start of the Kaveri Delta, which originates 16 kilometers west of Tiruchirappalli where the Kaveri River branches into two streams forming the island of Srirangam. The cyanobacterial samples were collected from various freshwater pond sand lakes in and around Tiruchirappalli district during the year 2013- 2014 at four different seasons i.e. Monsoon, June to September, Post monsoon; October-December, Premonsoon January to March, and Summer, Apr-May. The sampling stations were 1) Kollidam river (Srirangam), 2) Rice fields (Manachanallur) 3),Freshwater lake (Thiruverumbur), 4) Freshwater lake (Mathur) and 5) Pond (Vayalur). Samples were collected using forceps, knives and plankton net (meshsize 42μm).

Cyanobacterial strains Isolation and Purification

The collected samples were observed directly under a microscope for the determination of major cyanobacterial morphotypes and their relative abundance, special attention was given for documenting and quantifying the cyanobacterial strains based on the morphological descriptions (cell shape, width length of cells trichome width, the shape of both intercalary and cells, presence of sheath, pigmentation, presence and positioning of heterocyst, etc.). The cyanobacterial samples were isolated and purified based on the methoddescribed by Rippka et al., (1979). The purified cyanobacteria were inoculated in BG-11 medium and incubated at 25 ± 2ºC with illumination at 25-30 μmol photon m -2 s -1continuous white light. The cultures were tested for purity by repeated subculturing and observation under the microscope. Cyanobacterial specimens were identified based on morphological descriptions [Geitler, L. 1932] [Desikachary T.V] [Starmach K] [10,11,12]. Photomicrographs were taken using an Optica Labomed Microscope E-400 with H-111and confocal laser scanning microscope (LSM -710, Carlzeiss, Germany).

Physicochemical parameter analysis

The physicochemical analysis of water includes pH, electric conductivity, carbonate, bicarbonate, chloride, sulphate, calcium, magnesium, sodium, potassium,which were estimated by standard procedure[APHA][13].

Seasonal variation and correlation coefficient analysis

Correlation coefficients were calculated for cyanobacterial abundance, Physico-chemical parameters and the analysis of variance tests were also made for hydrological parameters concerning the sampling station. All the data were analysed statistically using SPSS statistical software (version 17.0 for Windows, SPSS, Chicago, IL, USA).

Cyanobacterial diversity assessment

Cyanobacterial diversity was calculated for 2013 to 2014 years at five different seasons as mentioned earlier. Results were tabulated separately to know the cyanobacterial species diversity for sampling strains and seasons during the study period.

RESULTS AND DISCUSSION

Cyanobacterial diversity assessment

Totally, 63 species of cyanobacteria belonging to 10 families namely Chroococcaceae, Merismopediaceae, Microcystaceae, Nostocaceae, Pseudanabaenaceae, Phormidiaceae, Oscillatoriaceae, Rivulariaceae, Scytonemataceae and Xenococcaceae were identified from five different freshwater bodies throughoutthe study period. In this study nine species of the cyanobacteria viz., *Aphanothece microscopica, Aphanocapsa musicola, Anabaena variabilis, Anabaena* sp. *Nostoc punctiforme, Nostoc paludosum, Oscillatoria tenuis, Calothrix marchica, Calothrix membranacea* were common in Srirangam and Mathur Lake whereas, *Microcystis* sp. was predominant in Thiruverumbur lake. Maximum 37 species of 17 genera were recorded from Srirangam, followed by 17 species belonging to 7 genera, 15 species from 6 genera in Vayalur and Manachanallur, respectively. Six speciesnamely, *Anabaena* sp. *Oscillatoria tenuis*, *Oscillatoria princeps*, *Lyngbya majascula*,*Lyngbya spirals*, *Spirulina subsalsa* were common in all the sites surveyed (Table 1). Similarly, [Kensa Mary V] [15] reported a total of 33 species of blue green algae belonging to 18 genera under 3 families viz., Nostocaceae, Microchaetaceae and Oscillatoriaceae in paddy wetland Kanyakumari district, Tamilnadu, South India and this result are in consistent with the present study. Also, the distribution of the sespecies of algae might be an indicator of the low level of nitrogen in rice fields [Prasanna R. and Nayak S] [15] recorded more heterocystous forms while studying the abundance of blue green algae and their diversity in rice field soils of India. [Dey HS, Tayung K, And Bastia AK][16] reported the presence of 58 taxa belong to 20 genera among them 19 were heterocystous in the rice fields of Orissa. In the paddy fields, their significant contributions to soil fertility in terms of the physico-chemical, biological and soil-water relations are well documented [Nayak S, Prasanna R, Dominic TK, Singh PK] [17]. Role of cyanobacteria in soil conditioning and as soil bio-indicators were also reported.

Morphology and taxonomical assignment of cyanobacterial isolates

The taxonomic characterization of freshwater cyanobacterial species from freshwater bodies of different sampling sites in the study area was described below based on the key morphological characters by [Desikachary T.V] [11].

Physico-chemical analysis

In the present investigation water samples were collected from five distinct sites. The influence of fresh water pH was evaluated on the abundance and generic diversity. The physicochemical properties of water from all the sites were described including pH, total suspended solids (TSS), total dissolved solids (TDS), dissolved oxygen (DO), phosphate (PO_4) and nitrate (NO_3) content. In all the study sites, pH of water was in the alkaline range of 7.13 to 8.21.The relationship between alkaline conditions and cyanobacteria has been previously noted by several researchers [Nayak S, Prasanna R, Dominic TK, Singh PK] [18]. Physico-chemical analysis of water showed that the pH range from 6.9 to 8.1, (Fig 2) temperature from 27 to 30° C, (Fig 3) electrical conductivity from 0.4 to 1.0,

alkalinity-carbonate from 0.1 to 0.9 mg/L and bicarbonate from 2.2 to 6.2 mg/L, calcium from 0.5 to 2.0 mg/L,(Fig 4) magnesium from 1.2 to 3.2 mg/L, (Fig 5) sodium from 1.3 to 3.4 mg/L, (Fig 6) chloride from 1.0 to 3.3 mg/L,(Fig 7). potassium from 0.19 to 4.2 mg/L,(Fig 8) and sulphate from 0.01 to 0.9 mg/L, (Fig 9) and sodium carbonate from 0.1 to 2.9 mg/L.[Vijayan D, Manivannan K, Santhosh kumar S, Pandiaraj D, Mohamed ImranM, Thajuddin. N] [19] showed that in the physico-chemical analysis of fresh water in Gundur Lake, Tiruchirappalli District, the pH was shown to be neutral and slightly above neutral favoring the microalgae dominance. Temperature was around 35°C and high light intensity with typical high photosynthetic condition. Dissolved oxygen of around 4-7 mg L^{-1} and chloride content of200-500 mg L^{-1} which also favours the algal population. At the same station very higher concentration of nitrate and nitrite contents was already reported by [Mohideen BMG, Hameed PS, and Shajitha C] [(20)]. The high nitrate content leads to the eutrophication.

Seasonal distribution of cyanobacterial species

During the year 2013-2014 of study, the cyanobacterial diversity was shown to be the highest number of species was recorded during Monsoon and the diversity decreased towards the summer. During the period in Monsoon (Jun 2013– Sep 2013), a maximum number of 36species were recorded in St-2, followed by 28 species in St-4, and 26 species in St-1.Whereas only 16 and 10 cyanobacterial species were recorderd during the same periodin St-5 and St-3, respectively. Similarly, during the post-monsoon period of Oct 2013-Dec 2013 the number of cyanobacterial species diversity was changed and the highest number of species diversity was observed in St-2 which is 26, whereas a fairly nochange in St-1 when compared to the monsoon and about 25 species were recordedduring this period and followed by the 11, 8 and 2 species in St-3, St-5 and St-4,respectively.During summer the number of species was less than 10 in all the stations. Highest number of 9 species were observed in St-1, St-4, and St-5 followed by 4 and 3species in St-2 and St-4, respectively. In pre-monsoon period the number of species were even decreased and the maximum species diversity of 7 was recorded in St-1followed by 5 species in St-2. Rivulariaceae and Microcystaceae were predominantly present in all the sampling periods in all areas followed by Nostocaceae,Chroococcaceae, Oscillatoriaceae, Merismopediaceae Pseudanabaenaceae, and Phormidiaceae whereas the members of Scytonemataceae and Xenococcaceae families were found in very mere or even absent in certain sampling periods (Fig. 10).

Dominance and diversity indices

Through this, we could identify a common and usually dominant cyanobacteria. Since many of the floristic studies on its abundance and distribution are validated, based on morphologic descriptions and physiological studies on axenic isolates. That is representative of the field populations.

CONCLUSION

Cyanobacterial biodiversity in fresh water habitats of Tiruchirappalli was highly varied with commercial value. The prime importance to focus on the fresh water cyanobacteria is because of their potential and application uses. The present study was aimed to study the biodiversity of cyanobacteria from five different habitats of Tiruchirappalli and to screening for their antimicrobial, antioxidant potential and its novel compounds.

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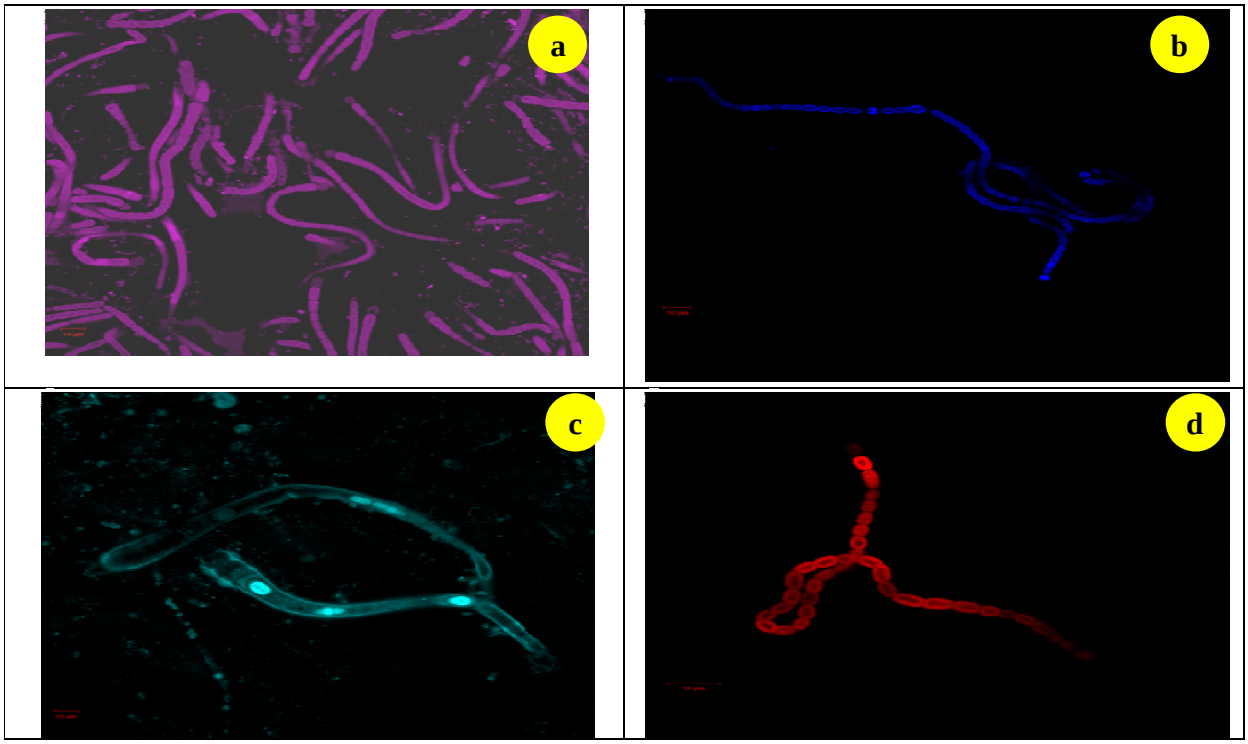
Table. 1 Diversity of cyanobacteria in different fresh water habitats in Tiruchirappalli during 2013-2014. St1- Kollidam St2- Thiruverumbur, St3-Mathur, and St4- Vayalur, St5- Manachanallur.

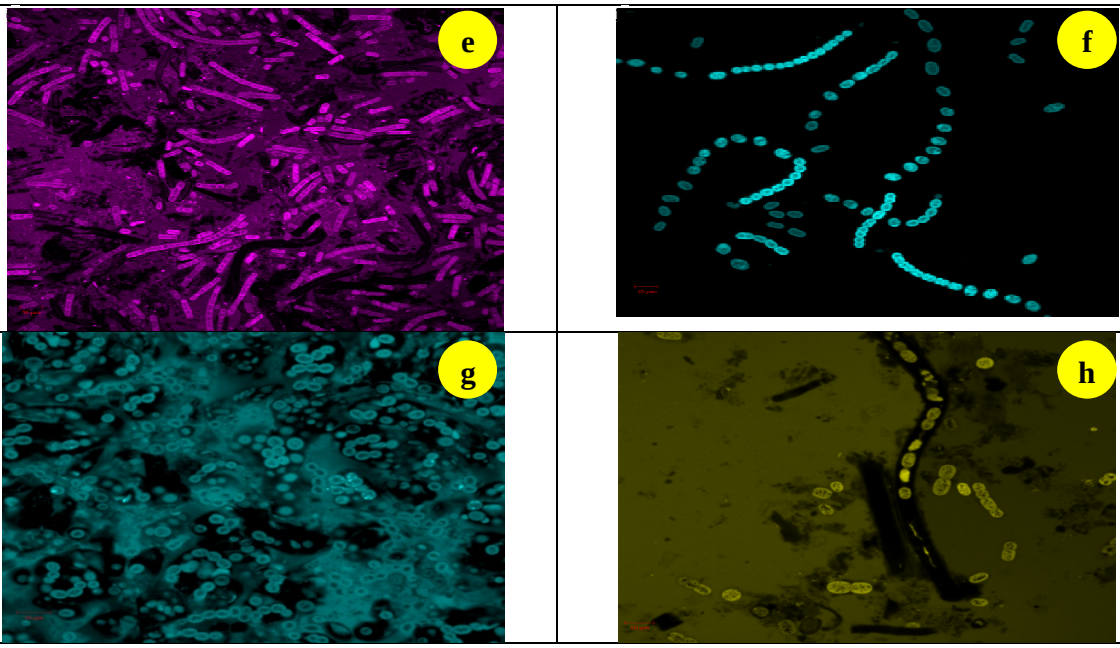
S. No	Cyanobacterial strains	Monsoon					Post- monsoon					Summer					Pre- monsoon				
		St 1	St 2	St 3	St 4	St 5	St 1	St 2	St 3	St 4	St 5	St 1	St 2	St 3	St 4	St 5	St 1	St 2	St 3	St 4	St 5
1	*Chroococcus turgidus*	+	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
2	*Chroococcus* sp.	+	++	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
3	*Chroococcus minor*	-	-	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
4	*Chroococcus minutes*	-	+++	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
5	*Aphanocapsa littoralis*	-	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
6	*Aphanocapsa mucilcola*	-	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+	-
7	*Aphanothece nidulans*	-	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+	++
8	*Aphanothece saxicola*	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+	-
9	*Aphanothece microscopica*	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+	-
10	*Merismopedia aeruginea*	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+	-
11	*Synechococcus* sp.	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+	-
12	*Gleocapsa* sp.	+++	++	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
13	*Gleothece* sp.	+	-	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
14	*Microcystis robusta*	+	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
15	*Microcystis marginata*	+	-	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
16	*Aphanothece saxicola*	+	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
17	*Aphanothece microscopica*	+	++	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
18	*Merismopedia* sp.	+	-	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
19	*Synechocystis* sp.	+++	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
20	*Myxosarcina* sp.	+	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
21	*Microcystis ramosa*	++	-	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
22	*Anabaena variablis*	++	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
23	*Anabaena laxa*	+	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
24	*Anabaena spherica*	+	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+

25	*Anabaena* sp.	++	++	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
26	*Anabaena ellipsospora*	++	-	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
27	*Nostoc punctiforme*	+++	-	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
28	*Nostoc paludosum*	+	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
29	*Nostoc* sp.	+	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
30	*Nostoc calciola*	-	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
31	*Notosc muscorum*	-	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	+	+
32	*Nostoc commune*	-	-	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
33	*Cylindrospermums* p.	+	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	+	+
34	*Oscillatoria princeps*	+	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	+	+
35	*Oscillatoria tenuis*	++	-	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	+	+
36	*Oscillatoria* sp.	++	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	+	+
37	*Oscillatoria formosa*	+	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	+	+
38	*Oscillatoria Subbrevis*	+	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	+	+
39	*Oscillatoria limosa*	+	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	+	+
40	*Oscillatoria limentica*	+	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	+	+
41	*Lyngbya majuscula*	++	-	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	+	+
42	*Lyngbya spirals*	++	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	+	+
43	*Lyngbya mucicola*	+	-	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	+	+
44	*Lyngbya calcifera*	+	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	+	+
45	*Phormidium fragile*	+	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	+	+
46	*Phormidium* sp.	++	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
47	*Phormidium tenue*	+	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
48	*Phormidium agardhii*	+	++	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+
49	*Spirulina* sp.	-	-	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
50	*Arthospira maxima*	+	-	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
52	*Calothrix marchia*	+++	+	++	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
53	*Calothrix* sp.	++	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
54	*Calothrix compacta*	+	-	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+

55	*Calothrix ghoshi*	+	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
56	*Rivularia globiceps*	++	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
57	*Rivularia aquatic*	+	-	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
58	*Rivularia* sp.	+	-	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
59	*Gleotrichia langicauda*	+	-	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
60	*Gleotrichia raciborski*	+	-	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
61	*Gleotrichia* sp.	++	-	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
61	*Scytonema* sp.	+++	-	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
62	*Scytonema boheneri schimidle*	+	-	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+
63	*Aulosira* sp.	++	-	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	-	+

- - Absent, ++ - Moderately present + - Present +++ - Abundant





*a).Rivularia*sp. *b). Nostoc*sp. *c).Calothrix*sp.*d). Nostoc*sp. *e). Oscillatoria* sp. *f.)Nostoc muscorum g). Nostoc*sp. *h). Anabaena* sp.

Fig. 1. CLSM microphotograph illustrating the morphological features of selected cyanobacterial strains

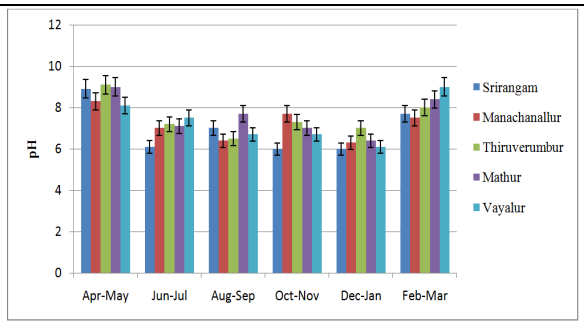


Fig. 2. Variations in pH at five sampling sites of Tiruchirappalli district during the year 2013 to 2014

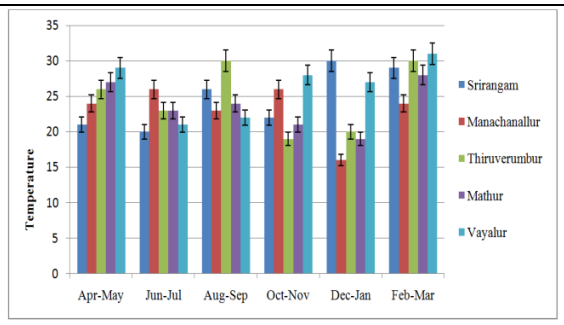


Fig. 3. Variations in Temperature at five sampling sites of Tiruchirappalli district during the year 2013 to 2014

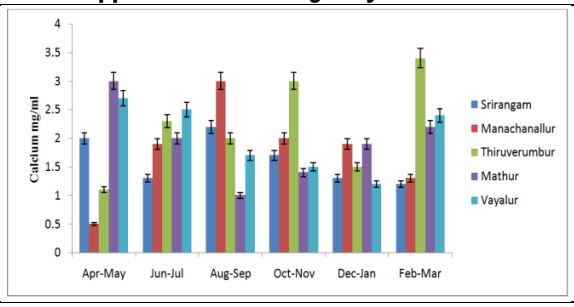


Fig. 4. Variations in calcium level at five sampling sites of Tiruchirappalli during 2013 To 2014

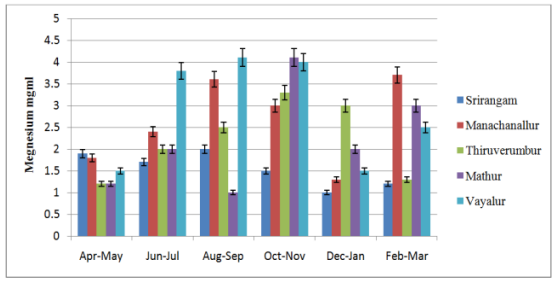


Fig. 5. Seasonal variations of magnesium at five stations of Tiruchirappalli district during the 2013 To 2014

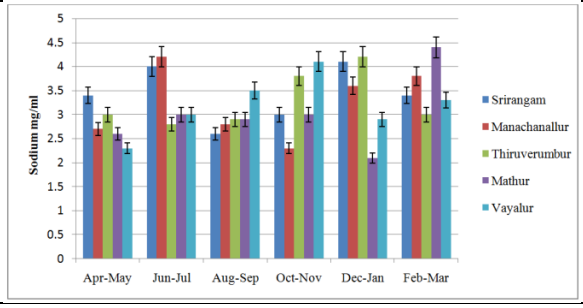


Fig. 6. Seasonal variations of sodium at five stations of Tiruchirappalli district during the year 2013 To 2014

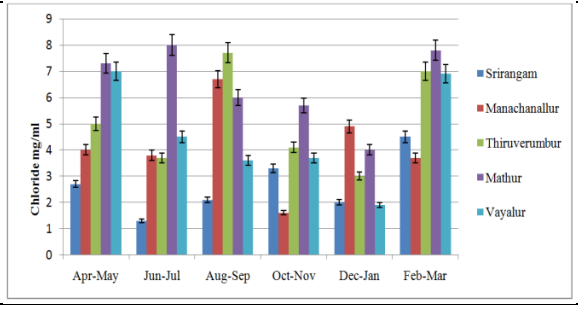


Fig. 7. Seasonal variations of chloride at five stations of Tiruchirappalli district during the 2013 To 2014

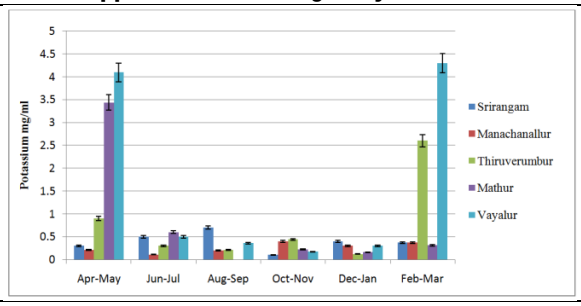


Fig. 8. Seasonal variations of potassium at five stations of Tiruchirappalli district during the year 2013 To 2014.

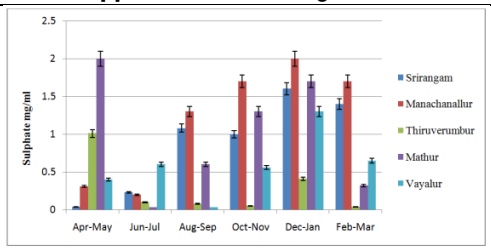
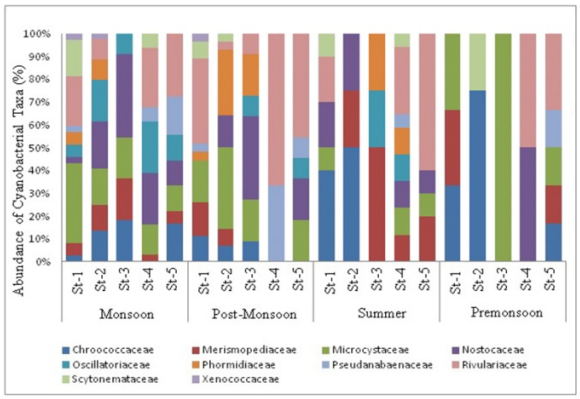
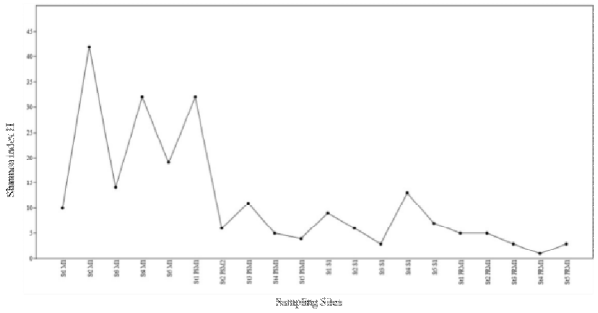


Fig. 9. Seasonal variations of sulphate at five stations of Tiruchirappalli district during the year 2013 To 2014



St1- Kollidam river, St2-Manachanallur, St3-Thiruverumbur, St4- Mathur and St5-Vayalur

Fig. 10. Abundance of cyanobacterial families identified with respect to sampling sites and seasons during the year (2013-2014).



M1- Monsoon St1- Srirangam - Kollidam river, PsM1- Post monsoon, St2- Manachanallur - Rice field, S1- Summer, St3- Thiruverumbur -Fresh water lake, PRM1- Premonsoon, St4- Mathur - Fresh water lake, St5-Vayalur -Pond

Fig. 11. Dominance and diversity indices of cyanobacterial strains with respective to various season

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RESEARCH ARTICLE

Anti-Hyperlipidemic Activity of *Tephrosia purpurea Linn.* Leaves in Triton X-100 Induced Hyperlipidemia in Rats

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ABSTRACT

The purpose of this study was to see if *Tephrosia perpurea* Leaves could help rats with Triton X 100-induced hyperlipidemia. Rodents were given a single dose of Triton X (100 mg/kg, i.p.) to induce hyperlipidemia. When compared to vehicle control and standard medication Atorvastatin (10 mg/kg), treatment with ethanolic extract of *Tephrosia perpurea* Leaves (100, 200, and 400 mg/kg, p.o) significantly reduced hyperlipidemia, i.e., decreased serum Total Cholesterol, Triglycerides, Low Density Lipoprotein Cholesterol (LDL-C), Very Low-Density Lipoprotein Cholesterol (VLDL-C), and increased serum High Density Lipoprotein Cholesterol (HDL-C). The results showed that an ethanolic extract of *Tephrosia perpurea* Leaves had a significant antihyperlipidemic effect.

Keywords: Triton X 100, hyperlipidemia, *Tephrosia perpurea*, Atrovastatin

INTRODUCTION

Cardiovascular infections are the leading cause of death in both developed and developing countries. Disruptions in lipid digestion as a result of oxidative stress are the primary risk factors for the onset and progression of these diseases [1].Death is mostly caused by coronary disease, stroke, atherosclerosis, and hyperlipidemia [2]. Hyperlipidemia related lipid issues are considered to cause atherosclerotic cardiovascular disease [3].Hyperlipidemia is described by raised serum absolute cholesterol, low thickness lipoprotein, and diminished high thickness lipoprotein levels. It is a condition when anomalous significant levels of lipids for example the greasy substances are found in the blood. This condition is termed as hyperlipoproteinemia [1]. Lipids are fats in the circulation system, generally isolated into cholesterol and triglycerides. Cholesterol travels via the circulatory system and interacts with cell structure and capacity. Triglycerides (TG) are a type of energy that can be used right away or stored in fat cells.TG is made in the liver from food or is retained from the gut [2]. Increased plasma levels of cholesterol and LDL have been linked to atherosclerosis in humans, and epidemiological evidence suggests that increased plasma levels

of HDL have a protective impact[3].There are many effective lipid-lowering designed medications, but none of them is effective for all lipoprotein issues, and each one has some negative side effects. It is imperative to investigate other substances derived from natural sources that are less harmful, more affordable, and able to deliver good outcomes and adequacy over time. Plant-based natural products have been used to treat a variety of disorders for a long time. We have chosen EETPL(Ethanolic extract of *Tephrosia purpurea* leaves) as anti-hyperlipidemic substance in Triton X (100 mg/kg) induced hyperlipidemia in rodents.

MATERIALS AND METHODS

Collection of plant material

Dr.M.Palanisamy, Scientist 'D'-In-Charge, Botanical Survey of India, Southern Regional Centre, and Coimbatore, India, authorised the collection of *Tephrosia perpurea* leaves. The leaves were gathered from the CES College of Pharmacy, Chinnatekur, and Kurnool districts. BSI/SRC/23/2016/Tech is the voucher number.

Preparation of plant extracts

The leaves were picked, cleaned in water, and dried in the shade. Using the Soxhlet extraction method, an ethanolic extract was generated by extracting powder with 95 percent ethanol. After the extraction was completed, the dissolvable was extracted using the steam distillation process. The anti-hyperlipidemic study used the ethanolic extract. The yield percentage is determined as 23.66 percent.

Preliminary phytochemical analysis [4]

Tephrosia perpurea ethanol extract was subjected to preliminary phytochemical analysis to determine the presence of several phytoconstituents; glycosides, saponins, and tannins were discovered (Table - 1).

Acute toxicity test

The acute toxicity tests were performed according to the Organization of Economic Cooperation and Development 423 guidelines [5].

Antihyperlipidemic studies -- Induction of Hyperlipidemia [6-7]

After overnight fasting for 18 hours [8], Wistar albino rats were given a single dose intraperitoneal infusion of Triton-X (100 mg/kg) in physiological saline solution to induce hyperlipidemia. The rats were placed into five groups, each with six rats.

Group 1: Normal group given standard pellet diet; water orally administered for 7 days
Group 2: Triton control group given a single dose of triton at a dose of 100mg/kg, i.p. After 72 hours of triton infusion, received a daily dose (p.o) for 7 days.
Group 3: Single dose of Triton (100 mg/kg, i. p). After 72 hours of triton infusion, received a daily dose of Atorvastatin 10 mg/kg, p.o. for 7 days.
Group 4: Single dose of Triton (100 mg/kg, i.p) after 72 hours of triton infusion, received a daily dose of *Tephrosia perpurea*100mg/kg for 7 days
Group 5: Single dose of Triton (200 mg/kg, i.p) after 72 hours of triton infusion, received *Tephrosia perpurea* 200mg/kg for 7 days.
Group 6: Single dose of Triton (400 mg/kg, i.p) after 72 hours of triton infusion, received *Tephrosia perpurea* 400mg/kg for 7 days.

Collection of blood

Blood was taken from the retro orbital sinus on the eighth day, under light ether anaesthesia and gentle ether sedation. The blood samples were centrifuged for 10 minutes, and then serum tests were collected and used to investigate several biochemical characteristics.

Biochemical investigation

The serum was measured for TC [9] , TG [10] ,L[11-12] , LDL, VLDL by standard kits provided by, Ang Strom PvTLtD, Vadodhara, India.

The part of LDL-C in the serum was determined by utilizing Friedewald'ss equation as follows [13]

LDL-C = Total cholesterol – (HDL-C + VLDL-C)

VLDL-C = Triglyceride/5

Atherogenic index: TC/HDL [15]

Statistical analysis

The mean and standard error of the mean were used to present the findings. Using one-way analysis of variance and Dunnett's test, the significance of differences between the groups was investigated.

RESULTS AND DISCUSSION

Acute toxicity studies

Oral administration of *Tephrosia perpurea* extract was determined to be safe up to 2000mg/kg body weight. Animals were found to be well tolerated after 72 hours. There was no evidence of mortality or toxicity. For the current investigation, three dose levels were chosen: 100mg/kg, 200mg/kg, and 400mg/kg body weight. (IAEC/CESCOP/AUG-2016-05).

DISCUSSION

Irregularities in lipid metabolism are the primary cause of cardiovascular disease. Despite the fact that there is a vast class of hypolipidemic drugs used in the treatment, none of the currently available ones are completely effective, completely safe, and free of side effects. As a result, attempts are being made to identify safe and beneficial substances which enhance lipid metabolism and minimizing cardiovascular illnesses. In a few species, Triton X-100 has been widely utilized to increase the TG-rich lipoproteins and cause severe hyperlipidemia [16].The massive increase in plasma cholesterol and TGs caused by Triton X-100 infusion is mostly due to an increase in VLDL production by the liver, which is accompanied by a significant decrease in VLDL and LDL catabolism. In this study, EETPL was chosen to test for antihyperlipidemic activity in Triton X (100 mg/kg)-induced hyperlipidemic mice, which was nearly identical to the conventional atorvastatin medication used in the treatment. EETPL (Ethanolic extract of *Tephrosia purpurea* leaves) clearly reveals that at doses of 100, 200, and 400 mg/kg, TGs and cholesterol levels were reduced (Table - 2).The EETPL extricates reduction of TC was linked to a decrease in its LDL division, which is the goal of a few hypolipidemic medicines. The rapid degradation of LDL-C through its hepatic receptors for conclusive end as bile acids, according to this, can eventually lead result in cholesterol-lowering movement of the natural concentration. It is widely accepted that a reduction in plasma HDL is a risk factor for the development of atherosclerosis. HDL promotes cholesterol translocation from peripheral tissue, such as blood vessel dividers, to the liver for catabolism. The increase in HDL could make the atherosclerotic rate will be reduced. Increased levels of HDL (cardio protective lipid) could be due to an increase in the movement of lecithin cholesterol acetyl transferase, which plays a critical role in converting free cholesterol to HDL and then back to VLDLs (middle thickness lipoproteins), which are reclaimed by liver cells. The increased HDL-cholesterol level and lower cholesterol level alongside its LDL part, as seen in the results, could be due to increased cholesterol outflow and decreased cholesterol retention through the gastro intestinal tract. A rise in HDL-C has been linked to a reduction in the risk of coronary artery disease in a few studies. Increased TC and LDL-C values are important coronary hazard factors. Saponins are known to have lytic activity on erythrocyte films, which has been used to identify their location. Saponins' hemolytic activity is thought to be due to the aglycone moiety's affinity for layer sterols, particularly cholesterol, with which they form insoluble complexes[16].The finding unmistakably suggests that the hypolipidemic action of this restorative plant is due to the presence of the essential saponin in the concentrate. The antihyperlipidemic activity of

EETPL (100,200, and 400 mg/kg) in comparison to Triton X-100 demonstrates a significant decrease in TC, TG, LDL-C, and VLDL (P 0.001) and a critical increase in HDL-C (P 0.001) in a proportion compared to the standard atorvastatin treated group (Graph - 1).However, further research is required to gain a better understanding of the various mechanisms.

CONCLUSION

The goal of this research was to see if *Tephrosia perpurea* extract had antihyperlipidemic properties in Triton X-100-induced hyperlipidemic rats. *Tephrosia perpurea* was given to Triton-induced hyperlipidemic rats at varied doses along with standard drug Atorvastatin10 mg/kg. The levels of TC, TG, VLDL, and LDL were considerably reduced ($p<0.05$) after treatment with 400 mg/kg plant extract. In addition, the extract caused a substantial ($p<0.05$) increase in HDL levels. In a dose-dependent way, the atherogenic index was also reduced. To conclude, *Tephrosia perpurea* extract 400mg/kg may successfully reduce Triton-X 100-induced hyperlipidemia in rats, suggesting a potential protective role in coronary heart disease.

ACKNOWLEDGEMENT

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CONFLICTS OF INTEREST

We declare that we have no conflict of interest.

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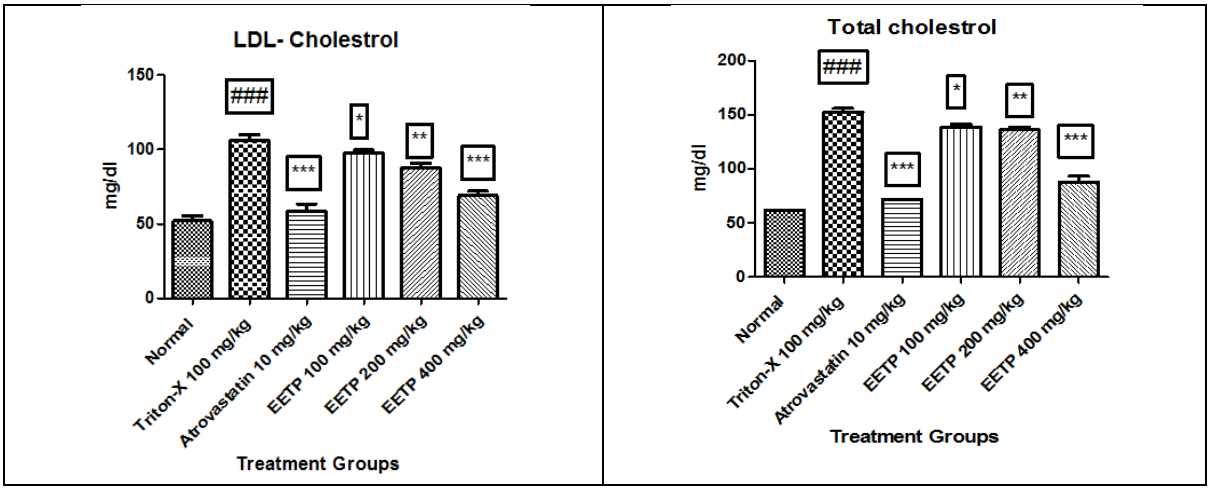
Table No 1: Phytochemical screening analysis

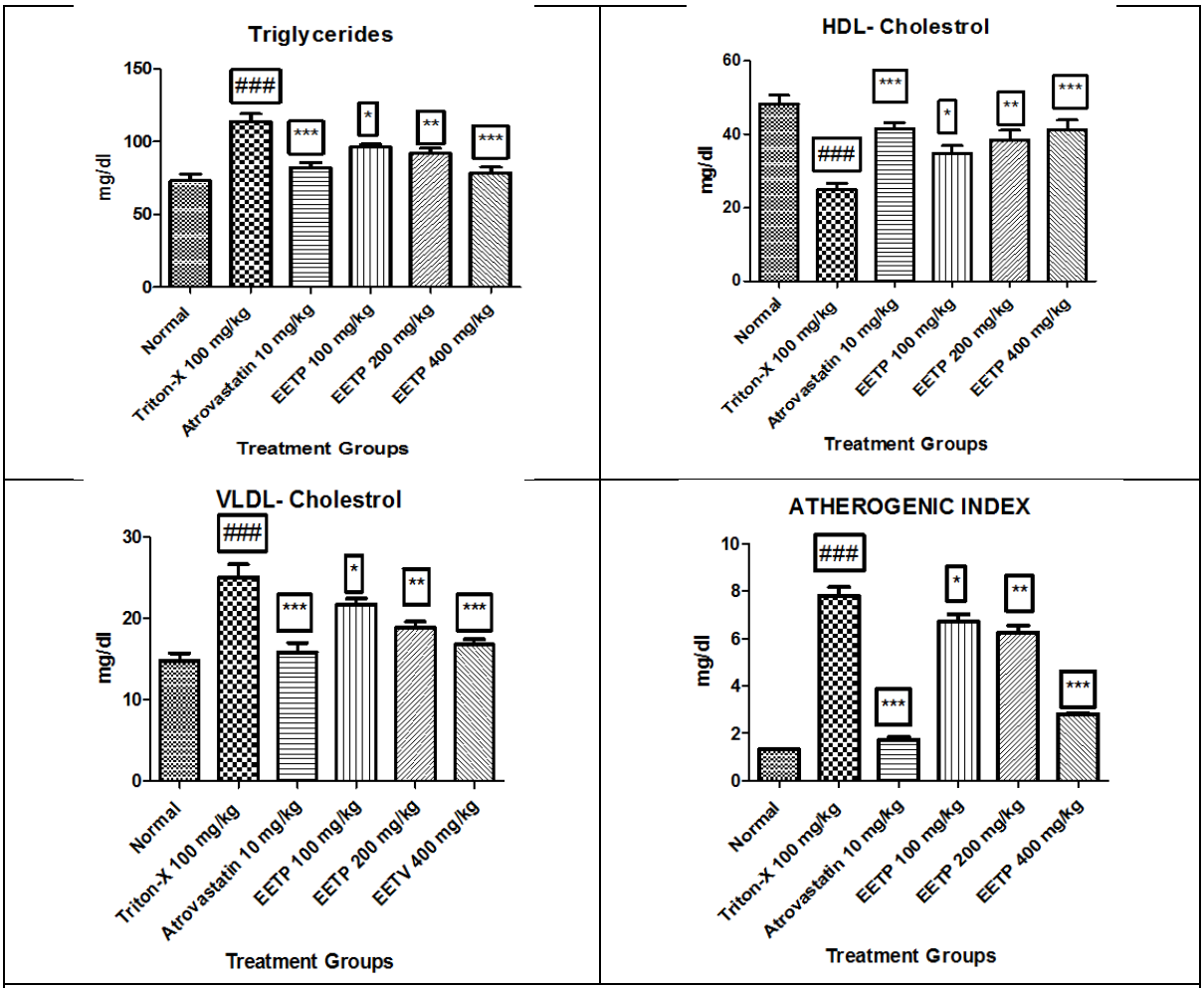
S.No	Phytochemical Test	Results
1.	Flavanoids test	Positive
2	Alkaloid's test	Negative
3	Steroid's test	Positive
4	Terpenoids test	Positive
5	Antracene glycosides test	Positive
6	Cardenolides test	Positive

Table No 2: Effect of *EETP* on biochemical estimation against Triton-X induced hyperlipidemia in rats

S. No	Groups	Total-Cholesterol mg/dl	Triglycerides	HDL mg/dl	LDL mg/dl	VLDL mg/dl	Atherogenic Index mg/dl
1	I	61.92 ± 0.12	73.12 ± 4.37	48.33 ± 2.33	52.01 ± 3.53	14.8 ± 0.94	1.325 ± 0.02
2	II	152.4 ± 3.49###	113.6 ± 5.48###	24.92 ± 1.77###	106.4 ± 3.61###	25.06 ± 1.61###	7.788 ± 0.37###
3	III	71.58 ± 0.45***	82.1 ± 3.58***	41.65 ± 1.53***	58.64 ± 4.65***	15.86 ± 1.51***	1.738 ± 0.11***
4	IV	139 ± 2.18*	96.43 ± 1.74*	34.78 ± 2.24*	97.64 ± 1.99*	21.75 ± 0.68*	6.712 ± 0.31*
5	V	136.2 ± 2.52**	92.08 ± 3.38**	38.5 ± 2.64**	87.91 ± 3.07**	18.86 ± 0.75**	6.263 ± 0.28**
6	VI	87.88 ± 5.36***	78.65 ± 3.84***	41.25 ± 2.68***	69.09 ± 2.97***	16.82 ± 0.68***	2.815 ± 0.03***

The values expressed as mean ± SEM, where n=6, All the data were analyzed by using one way ANOVA followed by dunnet's test. ***P<0.001, **P<0.01 as compared with control, ###P<0.001, #P<0.05 as compared with the triton-x100 group.





Graph No 1: Effect of *EETP* on biochemical estimation against Triton-X induced hyperlipidemia in rats (EETP: Ethanolic extract of *Tephrosia perpurea*)

The values expressed as mean ± SEM, where n=6, All the data were analyzed by using one way ANOVA followed by dunnet's test. ***P<0.001, **P<0.01 as compared with control, ###P<0.001, #P<0.05 as compared with the triton-x100 group.

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RESEARCH ARTICLE

Formulation and Standardization of Low Carbohydrate, High Protein Cookie Enriched with Omega -3 Fatty Acid for Diabetic Patient as a Healthy Snack

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ABSTRACT

Diabetes mellitus is one of the major public health problem which is increasing in the recent past. Diet plays a predominant role in management and prevention of type 2 diabetes. Consumption of carbohydrate rich foods is also one of the major reason for increasing body weight, which in turn leads to metabolic disorder. Previous research suggests that low carbohydrate, high protein with omega 3 fatty acid exerts significant effects on glycemic control, insulin sensitivity and body weight. To formulate a low carbohydrate, high protein cookie enriched with omega 3 fatty acid for diabetic individual. A healthy snack, Diab cookie which is rich in protein and omega 3 fatty acid with low carbohydrate was developed and acceptability tests were done. Easily available ingredients, such as oats, horse gram, roasted Bengal gram, almond, peanut, walnut, flax seed, milk, butter, which are also high in protein, omega 3 fatty acid while low in carbohydrate were selected and diab cookie was prepared and organoleptically evaluated. Selected nutrient were analyzed by standard method. The cookie scored an overall acceptability score of 4.5 out of 5, thus showing its acceptability. Nutrient analysis per 100 gms of diab cookie revealed, that it contains35.34 gms carbohydrate, 22.89 gms proteins and 3.44 g of omega 3 fatty acid (EPA, DHA, ALA) thus confirming that the formulated diab cookie is highly nutritious. To meet the requirements of the CHO, protein and omega 3 fatty acid/day, three cookies (16gram/cookies) would be required to be supplemented to the diabetic patients as a healthy snack. This formulated nutrient dense- diab cookie

which is low carb, high protein and omega 3 rich, ready to eat, easy to carry food product would be ideal for diabetic patients as a healthy snack.

Keywords: Diabetes, diab cookie, healthy snack, omega 3 fatty acid.

INTRODUCTION

Diabetes mellitus is a serious and increasingly prevalent global public health problem. The most recent WHO global report on diabetes stated that 422 million adults had diabetes in 2014 and 1.6million deaths are directly attributed to diabetes each year (WHO, Global report on diabetes, 2017). Dietary factors are of paramount importance in the management and prevention of type 2 diabetes. The prevalence is estimated to increase from 425 million people in 2017 to 629 million by 2045, with linked health, social, and economic costs. The importance of nutrition in the management and prevention of type 2 diabetes through its effect on weight and metabolic control is clear. Improper and inadequate dietary habits are leading contributor to morbidity and mortality worldwide according to the Global Burden of Disease Study carried out in 188 countries (Nita G Forouhi, 2018). Certain dietary modifications like small frequent meals and healthy snacking are cornerstone for glycemic control. In addition low carbohydrate, high protein enriched with omega 3 fatty acid play a significant role in adiponectin level, the protein hormone involved in decreasing the insulin resistance as well as fatty acid breakdown which in turn reduce central obesity. There are several snacking options available for diabetes such as yogurt, almonds, fruits, chickpea, whole grain cracker, biscuits. There is a need to make available nutrient dense- snack which will boost nutritional status, manage weight, control blood sugar and satisfy hunger without extra calories.

Need of the study

There were two important aspects which formed the basis of this study: 1.A healthy snack alternative to the usual cookies. 2. A snack that is rich in protein, omega 3 fatty and low in carbohydrates content which provides a favorable effect on glycemic control, insulin sensitivity, and body- weight control while still being appealing to the palate of individuals with T2DM.

The objectives of the study were

- To select ingredients that are low in carbohydrate, high in protein and omega -3 rich
- Formulate and standardize a snack item based on easily affordable and available ingredients
- Evaluate the organo- leptic acceptability
- Estimate the nutrient composition, and shelf life of the developed product

Methodology

The methodology involved in the conduct of the present study such as study area, design is explained below.

Place of study

This study was carried out in the food science lab, Department of Clinical Nutrition, Sri Ramachandra Institute of Higher Education and Research, (Deemed to be University) Porur, Chennai, India.

Experimental Study Design

Formulation of a product

Step 1- Selection of low carbohydrate, high protein with omega -3 rich ingredients

The ingredients selected for the making of the product include oats(*Avena sativa*), almonds (*Prunus dulcis*), roasted Bengal gram(*Cicer arietinum*), horse gram (*Macrotyloma uniflorum*), peanut (*Arachis hypogaea*), walnut (*Juglans*), flax seed (*Linum usitatissimum*), butter and milk. These items were chosen based on their composition of carbohydrate, protein and omega 3 fatty acid as per the information given in Indian Food Composition Tables (IFCT-2017) and

since they are easily available and easily preferable. The selected ingredients were purchased from a departmental store at Chennai.

Step 2- Formulation of cookie using selected ingredients

Standardization of a recipe requires appropriate quantity of ingredients to receive acceptable end product. Diab Cookies were prepared in three different variations with chosen ingredients and the product coded as A, B and C respectively. The quantity of ingredients and their variations is given in table 1 along with brief description of the method of preparation. All the recipe were subjected to organoleptic evaluation by a panel of five experts using a score card (5 point Hedonic scale).

Procedure for Diab Cookie

- In a dry pan, all the ingredients were roasted separately in a low flame and grounded into fine powder and kept aside.
- In a bowl, butter was added and stirred well, followed by adding powders of oats, almond, roasted Bengal gram, horse gram, peanut, walnut and flax seed.
- This was then mixed well by adding some milk until a soft dough was formed.
- The resultant Soft dough was made into round cookie shape manually and placed in a tray, in pre- heated oven (180^0 C) for 15 minutes.
- After 15 minutes, the tray was removed from the oven.
- The final product turned out to be Crunchy Cookies suitable for consumption.

Step- 3 Organoleptic evaluation by the panel members

Organoleptic evaluation consists of judging the quality of food by a panel of judges. The evaluation deals with measuring, analyzing and interpreting the qualities of food, as they are perceived by the senses of sight, taste, touch, size, shape, color of foods. The prepared cookies were tested foe acceptability in three variations by evaluating the different sensory attributes like color, appearance, flavor, texture, taste and overall acceptability by ten panel members. Five point hedonic scale was used to evaluate the cookies. The product with highest score for overall acceptability was (sample C) and therefore, the selected cookie (C) alone was subjected to nutrient analysis.

Step 4 – Organoleptic evaluation by consumers

The selected (sample C) was further subjected to organoleptic evaluation by ten diabetic subjects with an age range between 25-40 years admitted at Sri Ramachandra Hospital, porur. They were asked to score the products using the score card. The attributes score for appearance, color, flavor, texture, taste and overall acceptability. The score was given as very good (5), good (4), fair (3), average (2) and poor (1) for the sensory evaluation.

Step 5- Shelf life assessment of the developed cookies

The cookies were analyzed on their shelf life by two methods. The final cookies which were formulated were placed in an air tight container and kept at room temperature and refrigerator as well to evaluate their shelf life.

RESULT AND DISCUSSION

It was evident that sample C with highest score in attributes of appearance, color, texture, taste and overall acceptability. The product was very well accepted with a total score of 144 by panelist and subjects with T2DM. The selected sample C was subjected to nutrient analysis in a NABL accredited lab (Table.2) and compared with the RDA for carbohydrates, calories, protein and fat for sedentary adults. Glycemic control remains the primary target of therapy in patients with type 1 and type 2 diabetes. It is universally accepted that dietary carbohydrate is the main dietary determinant of blood glucose and restriction shows the greatest reduction in postprandial and overall glucose concentrations as well as HbA_{1c} (Richard D, 2014).

Since total carbohydrate intake has the greatest effect on blood glucose levels, evidence suggests that low-carb diets are safe and can improve blood glucose levels in T2DM, as well as helping to achieve weight loss and reducing the risk of heart disease in people with Type 2 diabetes (www.diabetes.org.uk). Consequently, a low-carbohydrate diet has gained popularity over the past 20 y. In addition, a systematic review conducted by 26 research teams in 2015 suggests that a low-carbohydrate diet with a carbohydrate content <45% of energy provides a favorable effect on glycemic control, insulin sensitivity, and body-weight control in T2D (Feinman RD, 2015). Studies have shown that increasing the protein percentage of energy upto~30% can provide favorable effects on glycemic control and other multiple health benefits in participants with T2D (Ajala O, 2013). High protein (HP) diet has been frequently used for weight loss in obese people. Currently, some studies have proved that a HP intake can enhance weight loss, glycemic control (Zhao, 2018).

Substituting unsaturated fatty acids for SFAs is commonly recommended for dietary adjustments in T2D. Among various unsaturated fatty acids, omega-3 PUFAs have shown favorable effects on glycemic control, insulin sensitivity, and chronic inflammation (Lorente-Cebrián, 2013). Dietary interventions play an important role in therapeutic strategies for patients with T2DM. The n-3 series (omega-3) of long-chain polyunsaturated fatty acids (FA), including eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), have been demonstrated to play hypolipidemic and anti-inflammatory roles, which lead to improvement of metabolism (Maryam Mazaherioun, 2017). The diab cookie have got better nutrient properties. Three cookiesper day (50 gm) would meet10 percentage of energy, 19 percentage of protein, >100 percentage of omega 3 fatty acid and only six percent of carbohydrate requirement per day.

CONCLUSION

Diab cookies developed in this study could be a better healthy snack option for the diabetic patients as it provides low carbohydrates, high protein and omega 3 fatty acid, which bestowa beneficial impact on glycemic control with a greater palatability and acceptability. The consumption or portion size of these cookies can be tailor made as per individual requirements of patients with type 2 diabetes mellitus.

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Table 1: Composition of the three variation of the product

Sample -A			Sample-B			Sample -C		
Nutrients	**Ingredients**	**Quantity (gm)**	**Nutrients**	**Ingredients**	**Quantity (gm)**	**Nutrients**	**Ingredients**	**Quantity (gm)**
CHO	**Oats**	25	**CHO**	**Ragi**	25	**CHO**	**Wheat**	25
Protein	Almonds	15	**Protein**	Almonds	15	**Protein**	Almonds	15
	Roasted Bengal gram	10		Roasted Bengal gram	10		Roasted Bengal gram	10
	Horse gram	25		**Black gram**	25		**Greengram**	25
	Peanut	20		Peanut	20		Peanut	20
	Walnut	10		Walnut	10		Walnut	10
Omega 3 FA	Flax seed	15	**Omega 3 FA**	Flax seed	15	**Omega 3 FA**	Flax seed	15
	Milk	20		Milk	10		Milk	15
	Butter	10		Butter	10		Butter	15

(100g – 6 numbers of medium size cookies)

Table 2: Estimation of nutrient analysis in the developed Diab cookies

Nutrient	Composition/100 gm
Energy	473.5 Kcals
Protein	22.89 gms
Carbohydrate	35.34 gms
Omega 3 fatty acid	3.44 gms
ALA	2.88 gms
EPA	456.7 mg
DHA	210.8 mg

Table 3: Comparison of nutrient analysis of Diab cookie with recommended intake for Sedantary Adults

Nutrients	Recommendation*	Diab cookie (50 gms)	% met
Energy (kcal)	2320	236.75	10
Protein (g)	60	11.44	19
Carbohydrate(g)	290#	17.67	6
Omega 3 fatty acid (g)	1.18	1.72	>100

*ICMR Dietary Guidelines for Indians, 2011

#50% of total calorie

Figure 1: Diab cookie

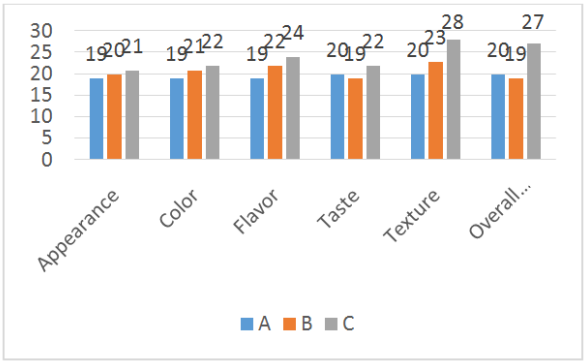

Figure 2: Comparison of organoleptic evaluation of three variations

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REVIEW ARTICLE

Effect of Plyometric Exercises in Improving Horizontal Jump Performance of Athletes.

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ABSTRACT

The objective of the study is to find whether 6 weeks Plyometric exercise is effective in improving horizontal jump performance of athletes. The study is quasi experimental in nature. 10 university level athletes were selected using simple random sampling. The horizontal jump length was measured using horizontal jump test before and after the 6week plyometric training. 6 week Plyometric exercises is significantly effective in improving horizontal jump performance of athletes. The t "cal" value was 13.90 and the t "tab" value was 2.262. The results of the study make us to conclude that 6 week Plyometric exercises is significantly effective in improving horizontal jump performance of athletes.

Keywords: Plyometric exercises, Horizontal jump performance.

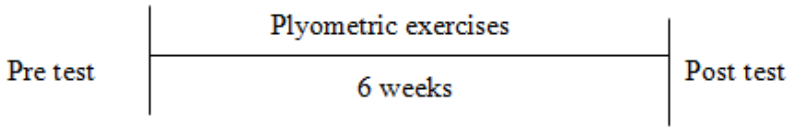
INTRODUCTION

Many athletic events rely on the ability of the athletes to produce power. Power represents one component of athletic fitness that may be most indicative of success in sports requiring extreme and rapid force production. Power can be increasing by either increasing that the amount of work or force that is produced by the muscle on by decreasing the amount of time required to produce the force. In many sports the ability to produce force rapidly may be more important than maximum force production. Plyometric training routines are thought to improve

explosiveness, or the capacity to use strength rapidly and strongly [1] The term plyometrics is derived from the Greek terms plythein or plyo, meaning to grow, and metric, meaning to measure. As a result, the objective of plyometrics can be thought of as "increasing the measurement."." Several studies have shown that plyometric training has a positive effect on isometric maximum voluntary contraction (MVC) strength [5] .Plyometric exercises are designed to enhance the athlete's ability to reach maximal force over the shortest period of time. Plyometric exercises involve stretching the muscles immediately before making rapid concentric contraction. Eccentric muscle contractions are rapidly followed by concentric contraction in many sport skills in team of individual sports. When muscles are stretched during an eccentric contraction, they store elastic energy, and this energy, accompanied by a rapid concentric contraction produces more power than an independent concentric contraction. Plyometric exercises such as jumping, hopping, skipping and bounding are executed with the goal of increasing dynamic muscular performance. Therefore, Plyometric exercises has been widely used for increasing dynamic athletic performance such as horizontal jump ability, speed, agility and muscle activation of lower extremities. The aim of the study is to find the effectiveness of plyometric exercises in improving horizontal jump performance of athletes. The need for the study is to promote the importance of specific exercises training which will suit to improve the performance of the individual.

Research Design

The study was quasi experimental in nature. 10 samples were selected by using simple random sampling procedure (lottery method).



Selection criteria

University level athletes were only included.
Age group of "18 to 24" were only included
Only male subjects were selected.
Subjects without any other associated injuries were only included.

Study population

All the college level athletes between the age group of 18 and 24 years at Vinayaka Missions Research Foundation – Deemed to be University, Salem**.** All the psychologically and medically fit athletes belonging to both genders without any other associated problem were taken as the population of the study.

Sample size and method of selection

Ten subjects from the population were selected using simple random sampling (lottery method).

Variables

Independent variable: Plyometrics
Dependent Variable: Standing Horizontal Jump performance.(Broad jump)

Validity and reliability of the tool

Broad jump test is a valid and reliable tool to measure horizontal jump performance.

Settings

The study was conducted in Vinayaka Mission's college of physical education, Salem.

METHODOLOGY

In this study, a careful attention on individual subjects who performed exercises were taken and they performed their exercises only under supervision. 10 university level athletes were selected for the study. The subjects are well explained about the program and they were co-operative too. As plyometric exercises are high intensity exercises only alternative days were selected for the training as continuous exercises might injure their tissues. Exercises were done on grass surface, as the cemented surface will increase the ground reaction force. All the subjects were asked to wear well cushioned stable shoes to absorb some of the inevitable impacts. All the subjects took part in the experiment on a voluntary basis signing a consent form and demographic data were collected from each participant. The purpose of the study was explained to all subjects. Before starting the exercise the subjects were checked for their performance using Broad jump test.

Broad jump test: The Broad jump test measures the horizontal distance jumped from a semi crouched position by use of the following protocol. The subjects were instructed to bend their knees upto about 90 degree angle while moving arms back in a winged position and thrust forward reaching as much as possible. Three trials of the jump test were allowed for the subjects and the highest score was noted as his horizontal jump reach. The measurement is taken from takeoff line to the nearest point of contact on the landing (back of the heels). Record the longest distance jumped (the best of three attempts). The subjects were given sufficient warm up and then provided with following form of plyometric exercises. These exercises were given to the athletes once a day on alternate days for a period of six weeks. At the end of 6th week, post-test scores of horizontal jump performance were measured in a similar fashion as that of pre- test scores and were recorded.

Observation and analysis

The collected data were subjected to paired "t" test. Statistical analysis using a paired t-test revealed that Plyometric exercises is significantly effective in improving horizontal jump performance of athletes.

DISCUSSION

The increase in the horizontal jump performance achieved might be due to the following reasons. The following quick mechanical analysis demonstrates the critical role of plyometrics (jump training) in athletic power output. When plyometric drills are performed, kinetic energy is generated and stored within the muscles. This energy is then utilised to perform mechanical work during the succeeding positive phase, which enhances performance [2]. Plyometric exercises involve stretching the muscles immediately before making rapid concentric contraction. Eccentric muscle actions followed by Concentric contractions (Plyometric training) increased maximum voluntary contraction, strength and neural activation [4]. Eccentric muscle contractions are rapidly followed by concentric contraction in many sport skills in team of individual sports. When muscles are stretched during an eccentric contraction, they store elastic energy, and this energy, accompanied by a rapid concentric contraction produces more power than an independent concentric contraction. Explosive plyometric activities have been shown to increase neuronal efficiency by improving neuromuscular coordination. Plyometrics and Balance training are effective at increasing measures of neuromuscular power and control [7]. Thus, plyometric training improves neuromuscular function by increasing the maximum speed at which muscles can contract. Ultimately, this technique results in the strengthening of the neurologic system, allowing for greater automatic neuromuscular coordination [3]. This special type of strength training exercises are characterized by a more forceful and rapid execution, generation of a higher power output. [6]

CONCLUSION

The result of the study makes us to conclude that plyometric exercises are significantly effective in improving horizontal jump performance.

Financial Support and Sponsorship
Nil.

Conflict of Interest
The authors have none to declare.

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Table 1: 6 week plyometric training protocol (Developed by Miller et al.,)

Training Week	Training Volume	Plyometric drills	Set x Repetition	Training intensity
1	90	Side to side ankle hops standing jump and reach front cone hops	2 x 15 2 x15 6 x 15	Low Low Low
2	120	Side to side ankle hops standing long jump lateral jump over barriers double leg hop	2x 15 2 x 15 6 x 15 10 x 3	Low Low Medium Medium
3	120	Side to side ankle hops standing long jump lateral jump over barrier double leg hops lateral cone hops	2 x 12 2 x 12 6 x 4 8 x 3 2 x 12	Low Low Medium Medium Medium
4	140	Single leg bounding standing long jump lateral jump over barrier lateral cone hops tunk jumping with knee up	2 x 12 3 x 10 8 x 4 3 x 10 4 x 6	High Low Medium Medium Medium

5	140	Single legs bounding jump to box double leg hops lateral cone hops tuck jump with knee up lateral jump over barrier	2 x 10 2 x 10 6 x 3 2 x 11 6 x 5 3 x 10	High Low Medium Medium High High
6	120	Jump to box depth jump to prescribed height double leg hops lateral cone hops tuck jump with knees up lateral jump single leg	2 x 11 4 x 5 6 x 3 2 x 10 4 x 5 2 x 10	Low Medium Medium Medium High High

Table 2: Paired "t" test for experimental group (Plyometric exercises)

Variable	t-cal value	t table value
Horizontal jump Performance	13.90	2.262

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RESEARCH ARTICLE

Paediatric Prescribing Pattern: Being AWaRe

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ABSTRACT

WHO introduced AWaRe (Access, Watch, Reserve) Tool in its Essential Medicines list (EML) in order to reduce the spread of antimicrobial resistance, antibiotic-related adverse events and cost of drugs. This has great importance when used to analyse antibiotic use by paediatric populations as they are high risk of detrimental effects from improper use of antibiotics. The study is aimed to analyze the utilization of antibiotics in Paediatrics as per WHO AWaRe guidelines. A Retrospective, Observational study carried out in one of the quaternary care hospital for a period of 11 months, starting from August 2019 to July 2020. This study analyses the antibiotic prescribing pattern in Paediatric population in accordance with AWaRe tool, along with the Access to Watch index and Amoxicillin clavulanic index. A total of 4875 prescriptions were obtained from both Inpatient (IP) and Outpatient (OP) departments. In OP, the median of access to watch index in young children (<6 years) were found to be 2.38, with intra quartile range (IQR 0.5 - 4.07) while, the median of access to watch index in IP patients were found to be 0.36 (IQR 0.16 - 0.75). Amoxicillin-clavulanic acid was the most prescribed antibiotic, within overall Amoxicillin-Clavulanic acid Index (amoxiclav index) less in IP patients with a mean of 11.58%, compared to OP (41.32%). It is observed in the study that, in Outpatient setting more than 2 access antibiotics being prescribed for each unit of watch antibiotics, among young children whereas in the inpatient setting, less than one access antibiotics was used for each unit of watch antibiotics. The

access to watch index helps to ensure the minimum use of watch antibiotics relative to access antibiotics. The assessment of amoxiclav index in paediatric patients, as it was the mostly prescribed antibiotic helps to identify the broad area for the stewardship.

Keywords: AWaRe, Access, Watch, Reserve, Stewardship

INTRODUCTION

Since the discovery, antibiotics play an indispensable role in the prevention and control of contagious diseases in both humans and animals and have significantly improved global health [1]. In line with the global action plan (GAP) objectives, WHO introduced AWaRe (Access, Watch, Reserve) Tool in its Essential Medicines list (EML) in 2017, categorising antibiotics into three groups [2,3]. WHO recommend that Access class antibiotics should be widely available, affordable and quality-assured, while minimising the use of Watch and Reserve class antibiotics. Watch class antibiotics are highest priority agents among the critically important antimicrobials for human medicine and have high resistance potential. Reserve class are "Last Resort" agents which should be accessible, but use should be tailored for treating infections with multi-drug resistant organisms when other options have failed / are not suitable [3]. Many reports concluded over two million childhood death per year due to pneumonia occurs because of scarcity in availability of life-saving antibiotics. With the aim to bridge the gap between excess and access, this new tool is initiated [4].The most widely used metric for antibiotic consumption is Defined Daily Dose (DDD), however, its use is limited in paediatrics due to marked heterogeneity in weight and height. The use of average body weight is applicable applied in adults unlike paediatrics. The first global study describing prescription pattern in paediatrics according to WHO AWaRe was done by analysing one day PPS (point prevalence survey) data of hospital antibiotic use from 56 countries [5]. This study suggests that being a simple metric, it could potentially be used to monitor and compare antibiotic use between and within hospitals. Moreover, the tool could be used as a simple traffic light metric of appropriate antibiotic use and efforts could be taken to develop and evaluate paediatric antibiotic stewardship programmes. Moreover, each country could use this tool to frame countries own AWaRe index (based on country-specific variation in AMR, antibiotic use, treatment guidelines) by embedding it into national antibiotic stewardship policy as well as encourage quality improvement programmes [6,7]. The AWaRe tool helps in the quick and promt monitoring of antibiotic prescribing pattern in paediatric population and can be easily implemented even in small hospitals without proper stewardship programs. This study will help in guiding the developing countries like India in the evaluation of antibiotics utilization patterns.

STUDY METHODOLOGY

This was a single centre, retrospective, observational study carried out in a quaternary care hospital. The study was carried out for a period of 11 months, starting from August 2019 to July 2020. All patients who received at least one antibiotic were included in the study. Patients taking topical antibiotics and patients with incomplete data were excluded. We analysed the appropriate use of antibiotics in accordance with AWaRe guidelines. The data were collected after the approval from the Institutional Ethics Committee. Patient data relevant to the study were obtained from both patient medical chart and the electronic medical record (EMR). The data regarding the patient's demographics, department, antibiotics prescribed were collected. Collected data were entered into EXCEL and SPSS 20 similar to "The AWaRe Classification database 2019" categorisation. The appropriateness of antibiotic usage was identified purely based on drug choice and not on dose, route, duration, clinical outcomes and other parameters. Access-to-Watch index calculated includes the analysis of relative use of access to watch antibiotics and calculated as a ratio of no. of access to watch antibiotics prescribed. Value less than 1, implies that few access antibiotics are used for each unit of watch antibiotics.

Amoxicillin-Clavulanic acid Index measured includes the percentage of use of amoxicillin-clavulanic acid in the total antibiotic prescription and calculated as the number of amoxicillin-clavulanic acid divided by total antibiotic prescriptions. Both indexes were evaluated in paediatrics. Then the pattern of antibiotic prescriptions in paediatrics (<19yrs) under AWaRe category were analysed.

RESULTS

A total of 4875 antibiotic prescriptions were analysed from Inpatient 37 and Outpatient 48 departments. About 2801 prescriptions were for males and 2074 prescriptions were for females.

DEMOGRAPHICS OF STUDY PARTICIPANTS

A total of 3354 prescriptions were analysed in the OP settings. Most of the antibiotics were prescribed to patients in the age group of young child (2-6yrs) (29.48%) with a mean age of 4.26yrs ± 1.05. About 1521 prescriptions were analysed among IP patients, most of which was prescribed to Infants (1month-2yrs) (22.35%) with a mean age of 12.8mnths ± 8.53. In OP about 58.25% of prescriptions were for males and 41.74% of prescriptions for females. In IP about 55.68% of prescriptions were for males and 44.31% of prescriptions for females.

ANTIBIOTIC USE IN PAEDIATRICS IN ACCORDANCE WITH WHO AWaRe TOOL

In the OP setting, 74.35% of the total antibiotics prescribed to infants were from the Access category. However, in adolescents, only 51.16% of the total antibiotics prescribed were from the Access category. About 43.97% of the total antibiotics prescribed to child were from the Watch category. However, in neonates, only 22.2% of the total antibiotics prescribed from the watch category. No reserve and not-recommended antibiotics were prescribed to neonates. Not-listed antibiotics were not prescribed to young child.

In the IP setting, 77.1% of the total antibiotics prescribed to neonates were from the Access category. In young child, only 21.67% of the total antibiotic prescribed from the Access category. About 68.63% of the total antibiotics prescribed to infants were from the watch category. However, in neonates, only 19.27% of the total antibiotics prescribed from the watch category. No reserve and not-listed antibiotic were prescribed to neonates. No not-listed antibiotics were prescribed to infants and young child.

Overall, in OP 64.13% of the total antibiotic prescribed to paediatrics were from the Access category whereas, 32.94% of antibiotic prescribed were from the Watch category and only 0.86% of the prescriptions were from the reserve category. In IP 33.92% of the total antibiotic prescribed to paediatrics were from the Access category whereas, 61.47% of antibiotic prescribed were from the Watch category and only 1.18% of the prescriptions were from the reserve category.

PATTERN OF AWaRe ANTIBIOTICS PRESCRIBING IN PAEDIATRICS

We observed different range of antibiotics used in paediatrics and represented in the table. Table 1, shows the pattern of prescribing in out-patients and in-patients. In OP patients, neonates only four different antibiotics under access and watch were prescribed, while no reserve and not recommended drugs were given. Cefalexin and Amoxicillin-Clavulanic acid found to be the commonly prescribed access antibiotics in paediatrics. In addition, among the watch antibiotics, azithromycin found to be the mostly prescribed. Only two antibiotics (Daptomycin, Linezolid) under reserve category and five fixed dose combinations (FDCs) were prescribed.

Linezolid and Cefixime-Clavulanic acid drugs were the most commonly prescribed reserve and not recommended antibiotics in all age groups, except neonates. In IP patients Amikacin in neonates and Amoxicillin-Clavulanic acid in other age groups were found to be the mostly prescribed access antibiotics. Watch antibiotic, Cefuroxime was found to be commonly used in all age groups. No Reserve antibiotics were prescribed and Cefoperazone-Sulbactam was

the only not recommended antibiotic given in neonates. Three different reserve antibiotics (Linezolid, Minocycline and Colistin) and 3 FDCs were prescribed to paediatrics and among them linezolid and Cefixime -Clavulanic acid were the commonly prescribed drugs.

ACCESS-TO-WATCH INDEX IN YOUNG CHILDREN

Access-to-Watch Index in Young children among Out-patients

Antibiotics were given to young children (<6yrs) in a total of 30 departments. In 2 departments, access antibiotics were not given and watch antibiotics were not prescribed in 12 departments. Fig.1 indicates the access-to-watch index of the remaining 16 department's. In 6 departments, index found to be less than 1. The relative use of access antibiotics found to be more in 9 departments, with highest in Paediatric surgery and Urology department.

Access-to-Watch Index in Young children among In-patients

In the IP setting, antibiotics were given to young children in a total of 29 departments. In 11 departments, no access antibiotics were given and no watch antibiotics in 2 departments. The Fig.2 shows the remaining 16 department's access-to-watch index. In 12 departments, index found to be less than 1. The relative use of access antibiotics found to be more in 3 departments, with highest in Neonatology department.

AMOXICILLIN-CLAVULANIC ACID INDEX IN PAEDIATRICS

Amoxicillin-Clavulanic acid Index in Out-Patients:

In the Fig.3, there were variation in the use of Amoxicillin-Clavulanic acid in different age groups. The mean of Amoxicillin-Clavulanic acid Index was found to be 41.32% in paediatric outpatients. The mean of access antibiotic use was 63.23%. We observed high index in young child age group. In infants and young child, more than half of the total prescriptions comprised of Amoxicillin-Clavulanic acid. In addition, use of this antibiotic found to be less in neonates (22.22%), even though access antibiotics use found to be more.

Amoxicillin-Clavulanic acid Index in In-Patients:

In the Fig.4, Overall in in-patients, use of amoxicillin-clavulanic acid was less with respect to total prescriptions, especially in neonates (1.21%). The mean of index was 11.58% in paediatrics. The mean of access antibiotics use was 35.83%. Among the different age groups, index was found to be more in Adolescents.

DISCUSSION

Access-to-Watch Index is the analysis of relative use of access to watch antibiotics. This study calculated the index in young children (<6yrs) similar to study by Yingfen Hsia *et al*.,[8] Index value less than 1, implies that the use of access antibiotics is less relative to watch antibiotics. In OP, the median of access to watch index was found to be 2.38, with IQR (0.5-4.07). This will be interpreted as more than 2 access antibiotics being prescribed for each unit of watch antibiotics, among young children. In IP, median of access to watch index found to be 0.36 (IQR 0.16-0.75). This suggests that less than one access antibiotics used for each unit of watch antibiotics in inpatients. Yingfen Hsia *et al*., pointed out that access to watch index was less than one in India [8]. Amoxicillin-Clavulanic acid Index was used to analyse the proportion of use of Amoxicillin-Clavulanic acid in the total antibiotics prescribed. In the study by Yingfen Hsia et al., they used Amoxicillin index, as it was the mostly prescribed antibiotic in paediatrics unlike this study amoxiclav were the most prescribed [8]. They revealed that median amoxicillin index was 30.7% (IQR 14.3-47.3) and India had less than 10%. In this study among neonates the index was less in both OP and IP. Comparing the overall index IP patients showed a lesser mean value of 11.58%, whereas OP had a value of 41.32%.

As a whole, most commonly used access antibiotic was amoxicillin-clavulanic acid, watch antibiotic Azithromycin, Cefuroxime and reserve antibiotic Linezolid were the mostly used drug. Cefixime -Clavulanic acid and Cefoperazone -Sulbactam were the commonly prescribed FDC drug. Neonates were commonly prescribed with

access and watch drugs. The WHO has already conceded the fact that AWaRe classification needed local adaptation because of the variation in AMR (Antimicrobial resistance) pattern in different regions, treatment guidelines and antibiotic use. By linking this AWaRe data with local epidemiology of antimicrobial resistance, one will be able to develop hospital specific AWaRe Index and quality improvement methods which can then be applied to strengthen the antimicrobial stewardship programs [6,7].

CONCLUSION

Overall, in OP 64.13% of the total antibiotic prescribed to paediatrics were from the Access category whereas, 32.94% of antibiotic prescribed were from the Watch category and only 0.86% of the prescriptions were from the reserve category. In IP 33.92% of the total antibiotic prescribed to paediatrics were from the Access category whereas, 61.47% of antibiotic prescribed were from the Watch category and only 1.18% of the prescriptions were from the reserve category. More use of Watch antibiotic among IP compared to OP. WHO aims to increase Access antibiotics use greater than 60% of the total usage. From this study it was observed that in OP setting 64.13% of the total antibiotic prescribed to paediatrics were from the Access category while, in IP setting 33.92% of the total antibiotic prescribed to paediatrics were from the Access category. The study has shown the feasibility of applying the AWaRe Classification in a health care facility, especially its application in paediatric patients. Most commonly used metrics DDD is of less importance in paediatrics because of the difficulty in assuming the average body weight. The AWaRe tool is simple and helps to easily estimate the use of antibiotics under different classes. The access-to -watch index helps to ensure the minimum use of watch antibiotics relative to access antibiotics. The assessment of Amoxicillin - Clavulanic acid index in paediatric patients, as it was the mostly prescribed antibiotic helps to identify the broad area for the stewardship.

DECLARATION OF CONFLICTING INTERESTS

No conflicts of interest with respect to the research, authorship and/or publication of the article.

AUTHORS CONTRIBUTION

Conceptualization- Anup. R. Warrier, Meby Susan Mathew, Priya K., Data Curation- Diya Shibuchan, Lis Maria, Femy Thomas, Maria Thomas., Formal Analysis- Diya Shibuchan, Lis Maria, Femy Thomas, Maria Thomas., Investigation- Diya Shibuchan, Lis Maria, Femy Thomas, Maria Thomas., Methodology- Meby Susan Mathew, Diya Shibuchan, Lis Maria, Femy Thomas, Maria Thomas., Project Administration- Meby Susan Mathew., Resources- Meby Susan Mathew, Priya K, Adhin Antony Xavier., Supervision- Meby Susan Mathew, Priya.K., Validation- Meby Susan Mathew., Visualization- Diya Shibuchan, Lis Maria, Femy Thomas, Maria Thomas., Writing – review & editing- Meby Susan Mathew, Priya K.

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Table-1: Pattern of AWaRe antibiotics prescribing in paediatrics.

OUTPATIENT SETTING				
	ACCESS	**WATCH**	**RESERVE**	**NOT RECOMMENDED**
NEONATES	Cefalexin(66.67%) Amoxicillin+Clavulanic acid (33.33%)	Fosfomycin (50%) Moxifloxacin (50%)	-	-
INFANTS	Amoxicillin+Clavulanic Acid (70.87%) Cefalexin (15.55%) Amoxicillin (10.22%) Amikacin (2.80%) Metronidazole (0.28%) Doxycyclin (0.14%) Nitrofurantoin (0.14%)	Azithromycin (42.17%) Cefixime (26.52%) Cefuroxime (11.74%) Moxifloxacin (8.26%) Cefpodoximeproxetil (3.48%) Levofloxacin (2.61%) Clarithromycin (1.30%) Erythromycin (0.87%) Ofloxacin (0.87%) Rifampicin (0.87%) Ceftriaxone (0.43%) Ciprofloxacin (0.43%) Meropenem (0.43%)	Linezolid (100%)	Cefoperazone+ Sulbactam (60%) Cefixime+ Clavulanic acid (40%)
YOUNG CHILD	Amoxicillin+Clavulanic acid (80.11%) Cefalexin (9.87%) Amoxicillin(7.05%) Trimethoprim+Sulfamethoxazole (1.97%) Metronidazole (0.42%) Amikacin (0.14%) Benzylpencillin(0.14%) Clindamycin (0.14%) Nitrofurantoin (0.14%)	Azithromycin (56.98%) Cefuroxime (23.40%) Cefixime (7.17%) Cefpodoximeproxetil (4.53%) Moxifloxacin (4.53%) Levofloxacin (2.64%) Ciprofloxacin (0.38%) Ofloxacin (0.38%)	Linezolid (100%)	Cefixime + Clavulanic acid (100%)
	Amoxicillin+Clavulanic acid (80.40%) Cefalexin(5.19%)	Azithromycin (42.47%) Cefuroxime (18.15%) Cefpodoximeproxetil (14.73%)	Linezolid (80%) Daptomycin	Cefpodoximeproxetil+ Clavulanic acid (44.44%)

CHILD	Trimethoprim+Sulfamethoxazole (5.19%) Amoxicillin (4.61%) Metronidazole (2.02%) Amikacin (0.86%) Clindamycin (0.86%) Nitrofurantoin (0.58%) Gentamycin (0.29%)	Cefixime (10.96%) Levofloxacin (3.42%) Fosfomycin (2.4%) Ciprofloxacin (1.71%) Ofloxacin (1.71%) Rifaximine (1.37%) Rifampicin (1.03%) Piperacillin+Tazobactam (0.68%) Clarithromycin (0.68%) Cefotaxime (0.34%) Moxifloxacin (0.34%)	(20%)	Cefixime + Clavulanic acid (38.89%) Cefoperazone + Sulbactam (16.66%)
ADOLESCENT	Amoxicillin+Clavulanic acid (64.08%) Trimethoprim+Sulfamethoxazole (15.28%) Amoxicillin (7.24%) Doxycyclin (5.36%) Nitrofurantoin (1.88%) Clindamycin (1.34%) Metronidazole (1.07%) Benzyl pencillin (1.07%) Benzathine Benzyl pencillin (1.07%) Amikacin (0.80%) Cefalexin (0.54%) Cefazolin (0.27%)	Azithromycin (24.21%) Cefpodoximeproxetil (19.5%) Cefuroxime (10.38%) Rifaximine (10.38%) Levofloxacin (7.86%) Cefixime (7.55%) Ciprofloxacin (5.35%) Clarithromycin (4.72%) Fosfomycin (3.46%) Ofloxacin (1.89%) Cefotaxime (1.26%) Moxifloxacin (1.26%) Teicoplanin (1.26%) Ceftazidime (0.31%) Piperacillin+Tazobactam (0.31%) Rifampicin (0.31%)	Linezolid (100%)	Ciprofloxacin + Tinidazole (48.28%) Cefpodoximeproxetil+ Clavulanic acid (37.93%) Cefixime + Clavulanic acid (6.9%) Ampicillin+ Dicloxacillin (3.45%) Cefoperazone + Sulbactam (3.45%)
INPATIENT SETTING				
	ACCESS	**WATCH**	**RESERVE**	**NOT RECOMMENDED**
NEONATES	Amikacin (48.69%) Ampicillin (43.98%) Metronidazole (4.19%) Amoxicillin+Clavulanic acid (1.57%) Cefalexin (1.57%)	Meropenem (25.53%) Piperacillin+Tazobactam (17.02%) Cefixime (12.77%) Teicoplanin (12.77%) Ciprofloxacin (10.64%) Cefuroxime (6.38%) Ceftriaxone (4.26%) Vancomycin (4.26%) Cefotaxime (2.13%) Cefpodoximeproxetil (2.13%) Erythromycin (2.13%)		Cefoperazone+Sulbactam (100%)
	Amoxicillin+Clavulanic Acid (50%) Cefalexin (12%) Amikacin (10%) Metronidazole (10%)	Ceftriaxone (27.04%) Cefuroxime (24.89%) Piperacillin+Tazobactam (11.16%) Cefpodoximeproxetil (10.3%)	Linezolid (80%) Colistin (20%)	Cefixime + Clavulanic acid (50%) Ampicillin+Cloxacillin (50%)

INFANTS	Trimethoprim+ Sulfamethoxazole (6%) Amoxicillin (4%) Clindamycin (3%) Cefazolin (2%) Doxycyclin (2%) Ampicillin (1%)	Meropenem (6.87%) Azithromycin (4.72%) Cefixime (4.72%) Levofloxacin (3.43%) Teicoplanin (1.72%) Vancomycin (1.29%) Ceftazidime (0.86%) Ciprofloxacin (0.86%) Ofloxacin (0.86%) Cefotaxime (0.43%) Clarithromycin (0.43%) Rifampicin (0.43%)		
YOUNG CHILD	Amoxicillin+Clavulanic acid (58.57%) Cefalexin (15.71%) Amoxicillin (8.57%) Amikacin(7.14%) Trimethoprim+Sulfamethoxazole (7.14%) Metronidazole (2.86%)	Cefuroxime (50.83%) Ceftriaxone (15.42%) Azithromycin (10%) Cefpodoximeproxetil (8.75%) Piperacillin+Tazobactam (3.75%) Cefixime (2.92%) Meropenem (2.92%) Levofloxacin (2.50%) Vancomycin (2.08%) Teicoplanin (0.83%)	Linezolid (100%)	Cefixime + Clavulanic acid (50%) Cefoperazone + Sulbactam (50%)
CHILD	Amoxicillin+Clavulanic acid (54.65%) Trimethoprim+Sulfamethoxazole (15.12%) Metronidazole (8.14%) Amikacin (6.98%) Amoxicillin (5.81%) Cefalexin (4.65%) Clindamycin (2.33%) Doxycyclin (1.16%) Nitrofurantoin (1.16%)	Cefuroxime (53.51%) Ceftriaxone (13.16%) Azithromycin (7.46%) Piperacillin+Tazobactam (4.82%) Cefpodoximeproxetil (4.39%) Meropenem (4.39%) Cefixime (2.63%) Teicoplanin (2.63%) Vancomycin (1.75%) Cefotaxime (1.32%) Rifampicin (1.32%) Ciprofloxacin (0.88%) Levofloxacin (0.88%) Fosfomycin (0.44%) Rifaximine (0.44%)	Linezolid (100%)	Cefoperazone + Sulbactam (86.67%) Cefixime+ Clavulanic acid (13.33%)
ADOLESCENT	Amoxicillin+Clavulanic acid (60.87%) Metronidazole(17.39%) Amikacin (7.25%) Clindamycin (4.35%) Doxycyclin(4.35%) Trimethoprim+Sulfamethoxazole (4.35%) Amoxicillin (1.45%)	Cefuroxime (57.75%) Piperacillin+Tazobactam (9.63%) Ceftriaxone (6.95%) Azithromycin 5.88%) Meropenem (4.81%) Cefixime (3.74%) Levofloxacin (3.21%) Teicoplanin (2.14%) Ciprofloxacin (1.60%) Cefpodoximeproxetil (1.07%)	Linezolid (57.14%) Colistin (28.57%) Minocycline (14.29%)	Cefoperazone + Sulbactam (85.71%) Cefixime + Clavulanic acid (14.29%)

		Cefotaxime (0.53%) Ceftazidime (0.53%) Moxifloxacin (0.53%) Rifampicin (0.53%) Rifaximine (0.53%) Vancomycin (0.53%)		

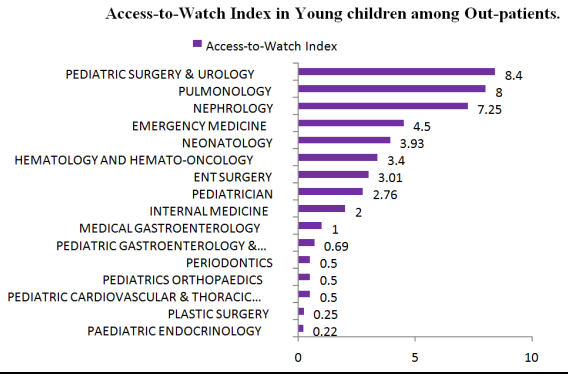

Fig.1 Access-to-Watch Index in Young children among Out-patients.

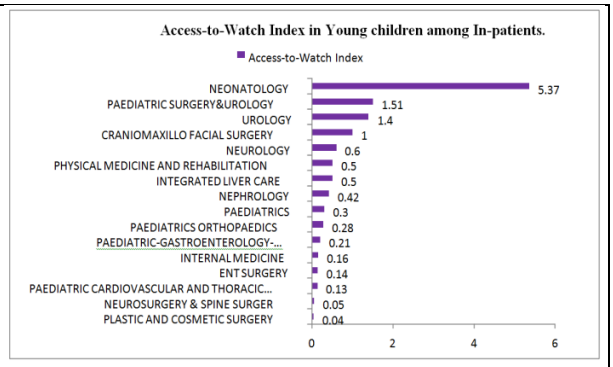

Fig.2 Access-to-Watch Index in Young children among In-patients

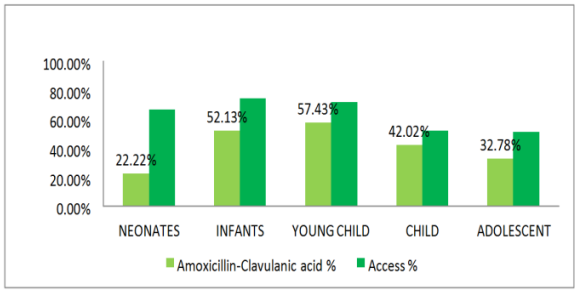

Fig.3 Amoxicillin-Clavulanic acid Index in Out-Patients.

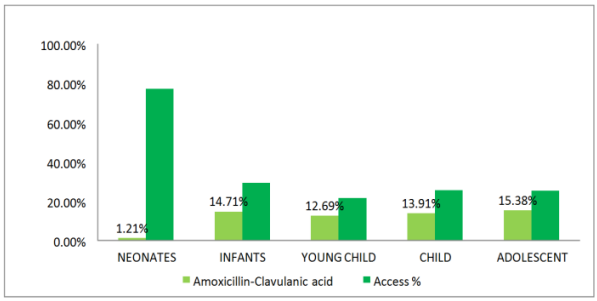

Fig.4 Amoxicillin-Clavulanic acid Index in In-Patients.

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RESEARCH ARTICLE

Concepts on t-Derivations of BH-Algebras

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ABSTRACT

The notion of BCK-algebras was proposed by Y Imai and K Iseki in 1966. In the same year Iseki introduced the notion of BCI-algebras, which is generalization of BCK-algebras. Y.B. Jun, E.H. Roh and H.S. Kim defined the notion of BH-algebras. Motivated by some results on derivations on rings and the generalizations of BCK and BCI-algebras. In 2019, P. Ganesan and N.Kandaraj introduced the notion of derivations on BH - algebras. In this paper, we study the notion of t - derivations on BH – algebras and investigate simple, interesting and elegant results.

Keywords: BH-algebras, BH-Sub algebras, t-derivations, Regular t-derivations on BH-algebras.

INTRODUCTION

Imai Y and Iseki K [7, 8] introduced the on axiom system of propositional calculi and have been extensively investigated by many researchers. Iseki K and Tanaka S [9] introduced the theory of BCK-algebras. It is known that the class of BCK-algebras is a proper subclass of the class of BCI-algebras. Jun Y.B, Roh E.H and Kim H.S [12] introduced the notion of BH-algebras. They investigated several relations between BH-algebras and BCK-algebras. In 1957, Posner E [18] introduced the notion of derivations in Prime rings theory. Also Lee P. H and Lee T. K [16] developed on derivations of prime rings.The notion of derivation in ring theory is quite old and plays an important role in algebra.

AlShehri N.O and Bawazeer S. M [4] introduced the notion of derivations of BCC-algebras. Many Research papers have appeared on the derivations of BCI-algebras in different ways. Zhan J and Liu Y. L [19] developed the notion of f-derivations on BCI-algebras. Muhiuddin G and Abdullah Al-roqi M [17] introduced on t-derivations of BCI-algebras. Recently, in the year 2019 Ganesan p and Kandaraj N defined and studied the notion of derivations,

Compositions of derivations f-derivations, composition of f-derivations, generalized derivations,(f, g)-derivations, generalized (g, h) - derivations and (G, H)-derivations of BH – algebras using the idea of regular derivations in BH-algebras and obtained some of its properties. The term algebra is used here to denote the algebraic structure defined on a non-empty set with a binary composition satisfying certain laws that resemble the algebra of logic but not the usual algebra. The notion of the derivations is the same as that in ring theory and the usual algebraic theory. Motivated by a lot of Work done on derivations of BH-algebras and on derivations of other related abstract algebraic, structures such as BCI, TM, and d-algebras. In this paper we introduce the notion of t-derivations of BH-algebras and investigate simple, interesting and elegant results.

BASIC FACTS ABOUT BH-ALGEBRAS:

In this section, we summarize some basic concepts which will be used throughout this paper [12]

Let U be a set with a binary operation $*$ and a constant 0. Then (U,$*$, 0) is called BH-algebra, if it satisfies the following axioms

(1) $u * u = 0$

(2) $u * 0 = u$

(3)If $u * v = 0 \; and \; v * u = 0 \Rightarrow u = v$ for all $u, v \in U$

Define a binary relation $\leq$ on U by taking $u \leq v$ if and only if $u * v = 0$.In this case (U, $\leq$) is a partially ordered set [20]

Let (U, $*$,0) be a BH-algebra and $u \in U$. Define $u * U = \{u * v | \; v \in U\}$,

then U is said to be edge BH-algebra if for any $u \in U, u * U = \{u, 0\}$

Let S be a nonempty subset of a BH-algebra U. Then S is called Sub algebra of U, if $u * v \in S \; for \; all \; u, v \in S$.

A subset I of a BH-algebra U is called an ideal of U if it satisfies

1.0 ∈ I

2. u $*$ v ∈ Iandv ∈ I implies that u ∈ I for all u, v ∈ U.

In BH-algebra X for all x. y, z ∈ U, the following Property holds [11]

1. ((u $*$ v) $*$ (u $*$ w)) $*$(w $*$ v) = 0

2. (u$*$ v) $*$ u = 0

3. (u$*$ (u $*$ v)) = v

For a BH-algebra U, We denote $u \wedge v$ for $v * (v * u), \; \forall \; x, y \in U$

CONCEPTS OF t - DERIVATIONS ON BH-ALGEBRAS

In this section, we introduce the notion of t-derivations on BH-algebras and prove some important results related with it. Also we discuss about regular t-derivations

Definition 3.1: Let U be a BH-algebra, then for any t ∈U, We mean self-map$\theta_t : U \to U$ by $\theta_t(u) = u * t \; \forall \; u \in U$.

Definition 3.2: Let U be a BH-algebra. For any$t \in U$.Define a self-map$\theta_t : U \to U$ we call θ_t a left-right-t-derivation (or (l, r)-t-derivation) of Uif it satisfies the identity

$\theta_t(u * v) = (\theta_t(u) * v) * (u * \theta_t(v))$

Example: 3.3: Let $U = \{0, a, b, c\}$ be a BH-algebra with following Cayley table.

*	0	a	b	c
0	0	0	0	0
a	a	0	a	0
b	b	b	0	0
c	c	c	c	0

For any $t \in U$, define $\theta_t : U \to U$ by $\theta_t(u) = u * t$ for all $u \in U$.
If $t = 0$, then $\theta_t(u) = u * t = u * 0$
If $t = a$, then $\theta_t(u) = u * t = u * a$
If $t = b$, then $\theta_t(u) = u * t = u * b$
If $t = c$, then $\theta_t(u) = u * t = u * c$
Then θ_t satisfies the identity $\theta_t(u * v) = (\theta_t u * v) \wedge (u * \theta_t(v)$
Hence θ_t is a (l,r) –t-derivation.

Definition 3.4: Let U be a BH-algebra. For any $t \in U$ Define a self map $\theta_t : U \to U$ is called a right-left-t-derivation (or (r,l)-t-derivation) of U if it satisfies the identity

$$\theta_t(u * v) = (u * \theta_t v) * (\theta_t(u) * v)$$

Example: 3.5:Let $U = \{0,1,2,3\}$ be a BH-algebra with following Cayley table.

*	0	1	2	3
0	0	0	0	0
1	1	0	1	0
2	2	2	0	0
3	3	3	3	0

For any $t \in U$, Define $\theta_t : U \to U$ by $\theta_t(u) = u * t$ for all $u \in U$
If $t = 0$, then $\theta_t(u) = u * t = u * 0$
If $t = 1$, then $\theta_t(u) = u * t = u * 1$
If $t = 2$, then $\theta_t(u) = u * t = u * 2$
If $t = 3$, then $\theta_t(u) = u * t = u * 3$
Then θ_t satisfies the identity $\theta_t(u * v) = \big(u * \theta_t(v)\big) \wedge (\theta_t(u) * v)$
Hence θ_t is a (r,l)-t-derivation.

Definition 3.6: Let U be a BH-algebra. For any $t \in U$. We define a self map $\theta_t : U \to U$ is called a t-derivation on U if θ_t is both (l,r)-t-derivation and (r,l)-t-derivation on U

Example 3.7: Let $U = \{0, a, b\}$ be a BH-algebra with following Cayley table.

*	0	a	b
0	0	0	0
a	a	0	0
b	b	b	0

For any $t \in U$, Define $\theta_t: U \to U$ by $\theta_t(x) = u * t$ for all $u \in U$.
If $t = 0$, then $\theta_t(u) = u * t = u * 0$
If $t = a$, then $\theta_t(u) = u * t = u * a$
If $t = b$, then $\theta_t(u) = u * t = u * b$
Then θ_t satisfies the identity
$\theta_t(u * v) = \big(u * \theta_t(v)\big) \wedge (\theta_t(u) * v)$ and
$\theta_t(u * v) = (\theta_t(u) * v) \wedge (u * \theta_t(v))$
Hence θ_t is a t-derivation.

Proposition 3.8: Let θ_t be a self map of a BH-algebra U. Then θ_t is a (l,r)-t-derivation of U.
Proof:
Let U be an associative and commutative BH-algebra and θ_t be a self-map of U.
Claim: $\theta_t(u * v) = (\theta_t(u) * v) \wedge \big(u * \theta_t(v)\big)$
$\theta_t(u * v) = (u * v) * t.$
$= \big(u * (v * t)\big) * 0.$ $(since\ v * t = u * (v * t) and\ u * 0 = u$
$= \big(u * (v * t)\big) * \Big(\big(u * (v * t)\big) * \big(u * (v * t)\big)\Big)$
$= \big(u * (v * t)\big) * \big(\big(u * (v * t)\big) * ((u * v) * t)\big))$
$= \big((u * t) * v\big) \wedge \big(u * (v * t)\big)$Since $(u \wedge v) = \big(v * (v * u)\big) = (\theta_t(u) * v) \wedge (u * \theta_t(v))$
Therefore $\theta_t(u * v) = (\theta_t(u) * v) \wedge (u * \theta_t(v))$
Hence a self-map $\theta_t: U \to U$ is a left-right-t-derivation of U.

Proposition 3.9: Let θ_t be a self map of a BH-algebra U. Then θ_t is a (r,l)-t –derivation of U.
Proof:
Let U be an associative and commutative BH-algebra and θ_t be a self-map of U.
Claim: $\theta_t(u * v) = \big(u * \theta_t(v)\big) \wedge (\theta_t(u) * v)$
$\theta_t(u * v) = (u * v) * t.$
$= \big(u * (v * t)\big) * 0.$ $(since\ (u * v) * t = u * (v * t) and\ (u * 0) = u$
$= \big(u * (v * t)\big) * \Big(\big(u * (v * t)\big) * \big(u * (v * t)\big)\Big)$
$= \big(u * (v * t)\big) * \big(\big(u * (v * t)\big) * \big(u * (v * t)\big)\big)$
$\big((u * (v * t)\big) \wedge \big(\big(u * (v * t)\big)$ Since $(u \wedge v) = v * (v * u)$
$\big(\big(u * (v * t)\big) \wedge ((u * t) * v)$ ((Since$(u * w) * v = (u * v) * w)$
$\theta_t(u * v) = (u * \theta_t(v)) \wedge (\theta_t(u) * v)$
Therefore $\theta_t(u * v) = (\theta_t(u) * v) \wedge (u * \theta_t(v))$
Hence a self-map $\theta_t: U \to u$ is a right-left-t-derivation of U.
From the above two proposition, we have any self-map $\theta_t: U \to U$ is a t-derivation of U.

Theorem 3.10: Let U be a BH-algebra andθ_t be a t-derivation on U. If $u \leq v$ and $\theta_t(u * v) = \theta_t(u) * \theta_t(v)$ for all $u, v \in U$ then $\theta_t(u) = \theta_t(v)$.

Proof:
Given $u \leq v$ and $\theta_t(u * v) = \theta_t(u) * \theta_t(v)$ for all $x, y \in U$
$u \leq v$ Implies $u * v = 0$
Now $\theta_t(u) = \theta_t(u * 0)$
$= \theta_t(u * (u * v))$
$= \theta_t(u) * \theta_t(u * v)$
$= (\theta_t(u) * (\theta_t(u) * \theta_t(v))) = \theta_t(v)$
Therefore $\theta_t(u) = \theta_t(v)$

Theorem 3.11: Let U be an edge BH-algebra. Then the following results hold.
1. If θ_t is a (l, r) –t-derivation on X then $\theta_t(0) = \theta_t(u) * u, \ \forall u \in U$.
2. If θ_t is a (r, l) - t-derivation on X then $\theta_t(0) = u * \theta_t(u), \ \forall u \in U$.

Proof:
Let θ_t be a (l, r)-t-derivation on U.
Then $\theta_t(0) = \theta_t(u * u)$
$= (\theta_t(u) * u) \wedge (u * \theta_t(u))$
$= (u * \theta_t(u)) * ((u * \theta_t(u)) * (\theta_t(u) * u)) = \theta_t(u) * u$.
Therefore $\theta_t(0) = \theta_t(u) * u$
Let θ_t is a (r,l)-t-derivation on U. Then $\theta_t(0) = \theta_t(u * u)$
$= (u * \theta_t(u)) \wedge (\theta_t(u) * u)$
$= (\theta_t(u) * u) * ((\theta_t(u) * u) * (u * \theta_t(u)))$
Therefore $\theta_t(0) = x * \theta_t(u)$.

REGULAR t – DERIVATIONS ON BH-ALGEBRAS.
Definition 4.1: A self-map θ_t of a BH-algebra U is said to be t-regular. If $\theta_t(0) = 0$.
Theorem 4.2: For any self-map θ_t of a BH - algebras U,then the following results hold.
1. If θ_t is a regular (l, r)-t-derivation of U, then $\theta_t(u) = \theta_t(u) \wedge u, \forall u \in U$.
2. If θ_t is a regular (r, l)-t-derivation of U, then $\theta_t(u) = u \wedge \theta_t(u), \ \forall u \in U$.

Proof:
Let $\theta_t(0)=0$. Then $\theta_t(u) = \theta_t(u * 0)$
$= (\theta_t(u) * 0) \wedge (u * \theta_t(0))$
$= \theta_t(u) \wedge (u * 0) = \theta_t(u) \wedge u$
Therefore $\theta_t(x) = \theta_t(x) \wedge x$.
Let θ_t be a (r,l) –t-derivatin on X such that $\theta_t(0) = 0$. Then $\theta_t(x) = \theta_t(x * 0)$
$= (x * \theta_t(0)) \wedge (\theta_t(x) * 0)$
$= (x * 0) \wedge \theta_t(x)$
$= x \wedge \theta_t(x)$
Hence $\theta_t(x) = x \wedge \theta_t(x)$

Definition 4.3: Let U be a BH-algebra. Define a binary relation $\leq$ on U by taking $u \leq v$ if and only if $u * v = 0$. In this case $(U, \leq)$ is a partially ordered BH algebra.

Proposition 4.4: Let U be a BH-algebra with partial order $\leq$ and θ_t be a t-derivation on U. Then the following results hold for all $x, y \in U$.
1. $\theta_t(u * v) \leq u * \theta_t(v)$
2. $\theta_t(u * v) \leq \theta_t(u) * v$
3. $\theta_t(u * \theta_t(u)) = 0$

Proof:

1. Let θ_t be a (r,l)-t-derivation on U.
   Then $\theta_t(u*v) = (u*\theta_t(v)) \wedge (\theta_t(u)*v)$
   $=(\theta_t(u)*v)*((\theta_t(u)*v)*(u*\theta_t(v)))$
   $=(u*\theta_t(v))$
   $\theta_t(u*v)*(u*\theta_t(v) = (u*\theta_t(v)*(u*\theta_t(v))= 0$.
   Therefore $\theta_t(u*v) \le u*\theta_t(v)$
2. Let θ_t be a (l,r)-t-derivation on U.

   Then $\theta_t(u*v) = (\theta_t(u)*v) \wedge (u*\theta_t(v))$
   $=\big(u*\theta_t(v)\big)*\Big(\big(u*\theta_t(v)\big)*(\theta_t(u)*v)\Big)$
   $=(\theta_t(u)*v)$
   There fore $\theta_t(u*v)*(\theta_t(u)*v) = (\theta_t(u)*v)*(\theta_t(u)*v) = 0$
   Hence $\theta_t(u*v) \le \theta_t(u)*v$
3. Let θ_t be a (r, l)-t-derivation on U.
   $$\theta_t\big(u*\theta_t(u)\big) = (u*(\theta_t(\theta_t(u)))) \wedge (\theta_t(u)*\theta_t(u))$$
   $=(u*\theta_t(\theta_t(u))) \wedge 0$
   $= 0*(0*(u*\theta_t(\theta_t(u)))$
   $=(u*\theta_t(\theta_t(u)))$
   $= (u*(\theta_t(u)*t))$
   $= (u*\big((u*t)*t\big))$ since $\theta_t(u) = u*t$
   $= (u*(u*(t*t)))$
   $=\big(u*(u*0)\big) = u*u = 0$

If θ_t is a (l,r) –t-derivation on X,
Then $\theta_t\big(u*\theta_t(u)\big) = (\theta_t(u)*\theta_t(u)) \wedge (u*\theta_t\big(\theta_t(u)\big))$
$= (\theta_t(u)*\theta_t(u)) = 0$

Proposition 4.5: Let θ_t be a regular (r,l)-t-derivation on U such that $\theta_t(u) = u \wedge \theta_t(u)$.If $u \le v$, then $\theta_t(u) \le \theta_t(v)$ for all $u, v \in U$.

Proof:

Since $u \le v, u*v = 0, \forall\, u, v \in U$.
To prove $\theta_t(u) \le \theta_t(v)$
Let $\theta_t$be (r,l)-t-derivation on U.
Now, $\theta_t(u)*\theta_t(v) = \big(u \wedge \theta_t(u)\big)*(v \wedge \theta_t(v))$
$=(\theta_t(u)*(\theta_t(u)*u))*(\theta_t(v)*(\theta_t(v)*v))$
$=u*v = 0$
Therefore $\theta_t(u)*\theta_t(v) = 0$
$\Longrightarrow \theta_t(u) \le \theta_t(v)$

Theorem 4.6:: Let U be an edge BH-algebra with partial order $\le$ and let θ_t be a regular t-derivation on U. Then$\theta_t(u) \le u$ for all $u \in U$.

Proof:

1. Let θ_t be a (r, l)-t-derivation on U and $\theta_t(0) = 0$
   Then $\theta_t(u) = \theta_t(u*0)$
   $= (u*\theta_t(0) \wedge (\theta_t(u)*0)$
   $= (u*0) \wedge (\theta_t(u))$
   $= u \wedge \theta_t(u) = \theta_t(u)*(\theta_t(u)*u)$
   $\theta_t(u)*u = (\theta_t(u)*(\theta_t(u)*u))*u$

$= u * u = 0$ Therefore $\theta_t(u) \leq u$.

2. Let θ_t be a (l, r)-t-derivation on U and $\theta_t(0) = 0$.

Then$\theta_t(u) = \theta_t(u * 0)$
$= (\theta_t(u) * 0) \wedge (u * \theta_t(0))$
$= (\theta_t(u) \wedge (u * 0)$
$= \theta_t(u) \wedge u$
$= u * (u * \theta_t(u)$
$\theta_t(u) * u = (u * (u * \theta_t(u))) * u$
$= \theta_t(u) * u$
$= \theta_t(0)$
$= 0$
$\theta_t(u) * u = 0 \Longrightarrow \theta_t(u) \leq u$.

Definition 4.7: Let U be a BH-algebra and θ_t be a t-derivation of U.
Define $Ker(\theta_t) = \{u \in U / \theta_t(u) = 0\}$

Theorem 4.8:Let θ_t be a regular t-derivation on BH- algebra. Then
1. $\theta_t(u) * u = u * \theta_t(u)$
2. $\theta_t(u) * v = u * \theta_t(v)$
3. $Ker(\theta_t) = \{u \in U / \theta_t(u)=0\}$ is a BH-subalgebra of U.

Proof:
1. Let θ_t be a regular t-derivation on BH-algebra U
Sinceθ_t be a t-derivation on U, θ_t is a (l, r)-t-derivation as well as θ_t is a (r, l)-t-derivation on U.
Considering θ_t is a (l, r)-t-derivation on U.
$\theta_t(0) = \theta_t(u * u)$
$=(\theta_t(u) * u) \wedge (u * \theta_t(u))$
$=(u * \theta_t(u)) * ((u * \theta_t(u)) * (\theta_t(u) * u))$
$=(\theta_t(u) * u)$_____1
Similarly consideringθ_t is a (r, l)-t-derivation on U.
$\theta_t(0) = \theta_t(u * u)$
$= (u * \theta_t(u)) \wedge (\theta_t(u) * u)$
$= (\theta_t(u) * u) * ((\theta_t(u) * u) * (u * \theta_t(u)))$
$= (u * \theta_t(u))$_____2
From 1 and 2 we have$\theta_t(u) * u = u * \theta_t(u)$
2. $\theta_t(u) * v = u * v$
$= u * \theta_t(v)$
Therefore $\theta_t(u) * v = u * \theta_t(v)$
3. Let $u, v \in Ker(\theta_t)$
Therefore $\theta_t(u) = 0$ and $\theta_t(v) = 0$
Now, $\theta_t(u * v) = u * v$
$= \theta_t(u) * \theta_t(v)$
$= 0$
Therefore$(u * v) = 0 \Longrightarrow u * v \in Ker(\theta_t)$
Hence$Ker(\theta_t)$ is a BH-subalgebra of U.

Definition 4.9: Let θ_t be a t-derivation of a BH-algebra U, then θ_t is said to be an isotone t-derivation if $u \leq v \Longrightarrow \theta_t(u) \leq \theta_t(v)$ for all $u, v \in U$.

Example 4.10: Let U be a BH-algebra with the following cayley table.

*	0	a	b
0	0	0	0
a	a	0	a
b	b	b	0

Then θ_t is an isotone t- derivation.

Definition 4.11: Let θ_t be a t-derivation of BH-algebra U. An ideal I of U is said to be θ_t –invariant if $\theta_t(I) \subseteq I$. where $\theta_t(I) = \{\theta_t(u)/u \in I\}$

Theorem 4.12: Every ideal on BH-algebra U isθ_t –invariant where θ_t is a t-derivation on U.

Proof:

Let I be an ideal of a BH-algebra$U$.

Let $v \in \theta_t(I)$

Then $v = \theta_t(u)$ for some $u \in I$

$v * u = \theta_t(u) * u$

$= 0 \in I$ (since $\theta_t(u) \leq u.\ \forall\, u \in I$)

Which implies$v \in I$

Thus$\theta_t(I) \subseteq I$ (Since $u * v \in I$ and $v \in I \Longrightarrow u \in I$)

Hence I is $\theta_t -$ invariant.

CONCLISION

An algebraic structure that arises from the study of algebraic formulations of propositional logic. Taking different theorems or statements of propositional logic, different algebraic structures could be obtained. The BH-Algebras is one such algebra. The derivations concepts are an important and very interesting area of research in the theory of algebraic Structures in Mathematics. The deep theory has been developed for derivations through various algebras. It plays an important role in algebras, algebraic geometry and linear differential equations.

We have considered the concept of t-derivations in BH-algebras. Finally, we investigated the notion of the regular t-derivations in BH-algebras. In our opinion these definitions and Main results may be extended to some other algebras such as BCI-algebras [1,2,10,13], d-algebras [5,6,14,15] and B-algebras [3] so forth. In future any Researcher can study the notion of t-derivations in different algebraic Structures which may have a lot of applications in various fields. This work is a foundation for the further study of the researcher on derivations of algebras. The future study of derivations on BH-algebras may be the following topics should be covered.

(a) To find the generalized derivations on BP-algebras.

(b) To find the t-derivations of Q-algebras, d-algebras, B-algebras and so on so.

(c) To find more results and its applications in t-derivations on BH-algebras.

(d) To find to investigate how these concepts could be applied to the field of computers for processing information.

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RESEARCH ARTICLE

A PDM Based MPPT Controller for Single Phase Grid Tied Inverter

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ABSTRACT

A new technique for increasing the efficiency of a Maximum Power Point Tracker (MPPT) system is described in this paper. A single phase inverter was used to transmit the maximum power produced from Photo Voltaic (PV) panels through a Pulse Density Modulation (PDM) regulated high frequency series resonant converter to the grid. The system's resonant converter and single phase inverter circuits were studied, developed, simulated, and implemented. Using the PDM control method, the proposed series resonant converter was run at resonant frequency under various solar radiation circumstances, and therefore the maximum power point was monitored. The resonance frequency was constantly tracked to ensure soft switching. Simulated and experimental findings for a 600 W prototype were provided by running the MPPT converter at 100 kHz. MPPT efficiency of 99 percent or higher was achieved. The Perturb and Observe (P&O) method with the PDM approach was used to obtain maximum power tracking of the PV panels. An LCL filtered inverter transmitted the produced PV power to the single phase grid. In the control of a single phase grid-tied inverter, a Proportional Integral (PI) controller was chosen.

Keywords: MPPT, PV, PDM, PI

INTRODUCTION

The energy industry contributes significantly to a country's economic development. Although fossil fuels have been utilised to produce the majority of the necessary energy, the rising prices and environmental issues they have generated are clear. As a result, it is critical to expand the use of renewable energy sources, which are inexpensive,

limitless, and environmentally friendly [1]. Solar energy systems, which are sustainable energy sources, are clean, simple to use, and easy to instal. PV systems are used to generate electricity from the sun. PV systems are made up of PV panels and converter circuits (DC-DC, DC-AC). Semiconductor materials used in PV panels directly transform sunlight into electrical energy. Depending on the operating conditions, generated electrical energy is transmitted to batteries, loads, or the grid through converter circuits [2]-[4]. PV panel output power varies constantly as a result of changing environmental variables such as temperature, shade, and solar radiation level. In this scenario, the power generated by PV panels fluctuates as well. As a result, in order to enhance the operational efficiency of PV generating systems, a more efficient and accurate MPPT algorithm should be developed [5], [6]. A wide variety of MPPT techniques have been suggested in the literature to monitor the maximum power point (MPP) for PV panels under different environmental circumstances. Because of its great efficiency, simplicity, and ease of implementation, the perturb and observe (P&O) technique is extensively employed in PV systems [7], [8].

The size of the DC-DC converter in the PV system should be small, light, and highly efficient, and switching losses should be minimal in order for the system to function efficiently. However, a hard switching situation arises during switching because either the current flowing through the power switch or the voltage on the switch terminals is not zero. Hard switching causes high switching losses, which restrict the frequency of the converter, resulting in poor efficiency and switch degradation. By adding an inductor (L) and a capacitor (C) to the standard converter circuit, lossless soft switching may be accomplished. To minimise switching losses at high operating frequencies, resonant converters and soft switching methods have been employed. As a result, smaller passive components and heat sinks are utilised in the design, resulting in a smaller and less expensive circuit [9]-[12]. For power management of the converter circuit, several control methods like as frequency control, pulse width modulation (PWM), phase shift, and bus voltage control are employed. Soft switching, however, cannot be ensured for all power levels using current control methods [13]. Because the power generated by PV panels is not constant all of the time, tracking the highest power point using a resonant converter at a constant operating frequency is not feasible. PDM control is utilised in resonant converter circuits for power tracking by providing soft switching conditions at each power point. PDM control progressively achieves the necessary output power by eliminating certain control pulses of the converter running at resonant frequency. Furthermore, using this control method, frequency may be maintained constant while providing a broad range of power control [14], [15].

The maximum power produced from the PV panels is transmitted to the grid via the grid linked inverter using the resonant converter in the system. According to worldwide IEC 61727 and IEEE 1547 standards [16], the total harmonic distortion (THD) value of the fundamental frequency current transmitted to the grid for grid-tied inverters must be less than 5%. To transfer current to the grid in line with these requirements, a filter must be employed at the inverter's output or the design must be modified appropriately. Because of its smaller size and cheaper cost, LCL filters are the most frequently used filter type [17], [18]. The control system of grid-connected inverters may regulate parameters such as voltage, current, and power. For current management of inverters used with PV systems without altering the dynamics of the control unit, PI and proportional resonant (PR) controllers are usually used [19], [20]. When looking through the literature, Fujita and Akagi [13] presented induction heater power management using a phase locked loop (PLL) based 16 PDM method of a complete bridge series resonant inverter for 4 kW at 450 kHz frequency. Esteve et al. [15] performed a similar research for induction heating applications with 50 kW power and 150 kHz frequency. To achieve optimum efficiency, Li et al. [20] utilised the PDM method for 50 W wireless power transmission. Borekci [21] utilised the PDM method to regulate the dimmer circuit in the lighting system. Koroec et al. [22] developed and tested a PDM mini inverter with a power rating of 100 W. Fan et al. [23] utilised the PDM method to transmit inductive power in rail cars. Jiang et al. [24] developed a cascaded boost converter with a bidirectional half bridge. The MPPT algorithm was utilised in the system as a variable step size.

The LCL filter was used to synchronise the full bridge single-phase PWM inverter before it was transmitted to the grid. Despite the fact that PDM control method has been utilised in numerous research, PDM controlled MPPT has not been employed for grid linked PV generating system. PDM control method, on the other hand, has considerable

value in MPPT system with resonant converter because it raises the restricted working frequency and overcomes switching losses, which are the fundamental issues of traditional hard switched MPPTs. As a result, a PDM-controlled MPPT system may be more efficient and effective. In light of this knowledge, a novel control technique for improving the efficiency of MPPT systems is given in this research. To that end, an MPPT system with a high frequency series resonant converter, which is utilised to transmit electrical energy from PV panels to a single phase grid, was developed utilising the PDM control method, and simulation and experimental investigations were carried out. The experiment was carried out by cascading two converters. A complete bridge series resonant converter is included in the first converter. PLL-based 16 PDM MPPT control was used to regulate a series resonant converter that can function under various solar radiation circumstances for PV panels. The PLL method was used to identify zero transitions of the current signal on the series resonant side, allowing the converter to function under zero current switching (ZCS) circumstances. P&O MPPT with 16 PDM offered power control by eliminating part of the control pulses based on the power of the PV panels without changing the switching frequency or the length of the switch's turn on. The second component is a grid-connected inverter. The modelling and experimental investigations of a PI current controller LCL filtered single phase grid connected inverter were carried out. Full bridge series resonant converter and single phase grid connected inverter components were cascaded, and the whole system was simulated and tested.

The analysis and control of PDM controlled full bridge series resonant converter

Series Resonant Converter : The series resonant converter circuit is shown in Fig. 1. The series resonant converter's resonant circuit is created by connecting a resonant capacitor and a resonant inductor in series. When the switching frequency (fs) of the series resonant converter equals the resonant frequency (fr), the circuit impedance is at its lowest (fs=fr). The output voltage and current of the inverter are in phase. As a consequence, ZCS is obtained during both switch on and turn off transients [25], [26]. Figure 2 depicts the converter's equivalent series resonant inverter circuit design. Converting the load resistance to the AC equivalent resistance value should be considered in the circuit analysis. The following equation [27] yields the AC equivalent resistance value.

PDM Controlled MPPT System

Figure 3 depicts the block diagram of the PDM-controlled MPPT system. Both the 16 PDM patterns database and the PI controlled P&O MPPT algorithm were put into the PSIM program's simplified C block. Fig. 4 depicts the flow diagram of the PI controlled P&O MPPT algorithm applied to the PDM approach and modified using the short step reference voltage method. By changing the reference voltage in response to power changes, the PI controlled P&O MPPT algorithm is given. Interference in the current and voltage readings measured from the PV panels is possible. By removing these interferences, a low pass filter was employed in the system to guarantee that MPP could be monitored properly [25-41]. The pulse density ratio rises as both power and voltage increase. The pulse density ratio rises as both power and voltage drop. In other situations, the pulse density ratio falls. As a result, the PDM control method provides the greatest power to be collected from the PV panel, and maximum power is transmitted to the load. Depending on the power change, the pulse density was increased or decreased by changing the reference voltage. The error value is calculated as the difference between the filtered PV voltage and the value of the obtained reference voltage (Vpv ref). To produce PDM signals, the error voltage value is transmitted via the PI controller. If the power change exceeds zero, the calculated delta value is added to the Vpv value to enhance the pulse density. If the change in power is less than zero, the pulse density is decreased by subtracting the delta value from Vpv.

Implementation of Grid Tied Inverter with PDM Controlled MPPT

Simulation and application experiments of a complete bridge series resonant power converter running at resonant frequency using the PDM control method with a 600 W PV panel were carried out. The switching frequency of the PI current controlled single phase inverter was found to be 10 kHz, and application experiments were conducted using this frequency. Figure 5 depicts a block diagram of a single phase grid linked inverter system with MPPT with a PDM controlled resonant converter. The MPPT method was used to produce PDM signals in the system. A PDM

logic circuit board was developed so that the circuit's switching signals could be produced rapidly based on the PDM signals. The PLL circuit was built using CD4046. The resonant inductor was calculated to be 115 H, whereas the resonant capacitor was calculated to be 16.46 nF. The high frequency transformer had a 1:4 ratio. For the series resonant converter circuit, IRFP 260N MOSFETs were utilised, while IRFP 460N MOSFETs power switches were used for the single phase inverter circuit. For both the resonant converter and inverter circuits, 6N137 optocouplers and TC4429 drivers were utilised. In the rectifier circuit for the series resonant converter circuit, IXYS DSEI60-12A diodes were utilised. The TMS320F28335 DSP control board was used to control both the resonant converter and the single phase inverter. PV panel current and voltage were measured using an ACS712 and an LV25-P sensor. The single phase current-voltage and DC bus voltage were measured with ACS756SCA and LV25-P hall effect sensors.

SIMULATION RESULTS

The PSIM 10.0 software was used to simulate the proposed system. The codes needed for system control were written in the reduced C block to produce embedded DSP codes. Figure 5 depicts a simulation screen picture of the proposed system. The solar radiation of the PV panels was set in the simulation research to be 250-500-750 and 1000 W/m2 correspondingly. The simulation result with maximum power tracking based on the progressive change in solar radiation level. Theoretical PV panel power is represented by (Po) in the simulation research, and PV panel power following the theoretical power is represented by (Ppv). The pulse density ratio was adjusted to 12/16 in order to get maximum power from PV panels under solar radiation at 500 W/m2. As shown in Fig. 6, four control pulses were eliminated based on the power needed by the PV panel, and the panels were run at MPP. Figure 7 depicts the simulation results of the PWM, gate control signal of the MOSFET, inverter output voltage (VAB), and resonant current I at a solar radiation intensity of 500 W/m2. The simulated picture in Fig. 7 demonstrates that switching is possible at ZCS. The pulse density ratio was adjusted to 14/16 in order to get the most power out of the PV panels under the solar radiation at 750 W/m2. As shown in Fig. 8, two control pulses were eliminated based on the power needed by the PV panel, and the panels were run at MPP. Figure 9 shows the simulation results for the measurement of 750 W/m2 solar radiation. To make simulation results comparable to experimental values, catalogue values of all system components were utilised in the simulation, and none of the values were regarded as ideal. According to the simulation results in Fig. 9, the MPPT efficiency for the situation at 500 W/m2 solar radiation was found to be 98.61 percent, the overall converter efficiency was found to be 93.55 percent, and the system efficiency was found to be 92.25 percent. The MPPT efficiency for the condition at 750 W/m2 solar radiation, on the other hand, was found to be 99.53 percent, and the efficiency of the whole converter was found to be 93.44 percent, while the system efficiency was found to be 93 percent. Furthermore, the MPPT efficiency at 1000 W/m2 solar radiation was found to be 99.8 percent, the efficiency of the whole converter was found to be 92.32 percent, and the system efficiency was found to be 92.14 percent.

CONCLUSION

The energy collected from PV panels running continuously at MPP under various solar radiation circumstances was transmitted to a single phase grid in this research. MPPT with PDM controlled resonant converter was developed and implemented to raise the restricted working frequency and solve harsh switching circumstances, both of which are issues with traditional PWM switched MPPTs. The MPPT algorithm conducted power control by eliminating certain control pulses of the converter running at resonant frequency using the PDM method. MPP tracking was achieved in the proposed series resonant converter by operating at resonant frequency and keeping ZCS constant. In a resonant converter, the impact of the PDM control algorithm on MPPT performance was investigated. The tracking effectiveness of the P&O MPPT algorithm running at various solar radiation levels and constant frequency was found to be high. As a consequence of the soft switching state, the prototype resonant converter was operated at frequencies over 100 kHz with minimal switching stress. Because the PDM-controlled MPPT and single phase inverter were cascaded, the energy generated by the PV panels was transmitted to the single phase grid.

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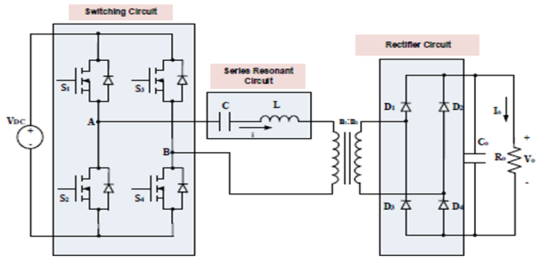

Fig. 1. Series resonant converter circuit.

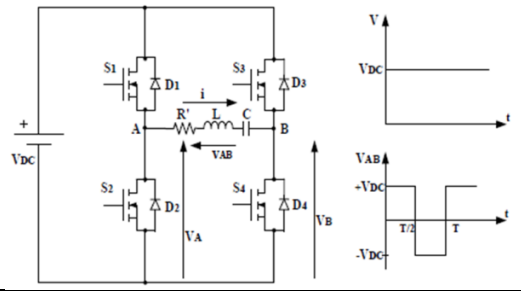

Fig. 2. Full bridge series resonant inverter circuit scheme.

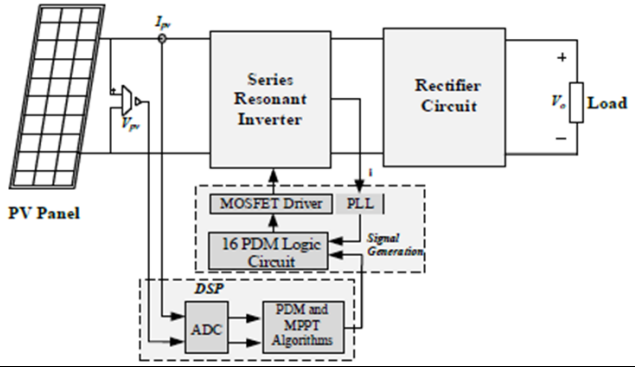

Fig. 3. The block diagram of the PDM controlled MPPT system

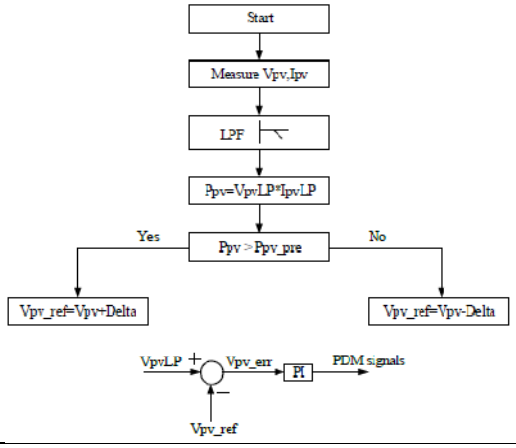

Fig. 4. The flow diagram of the PI controlled P&O MPPT algorithm

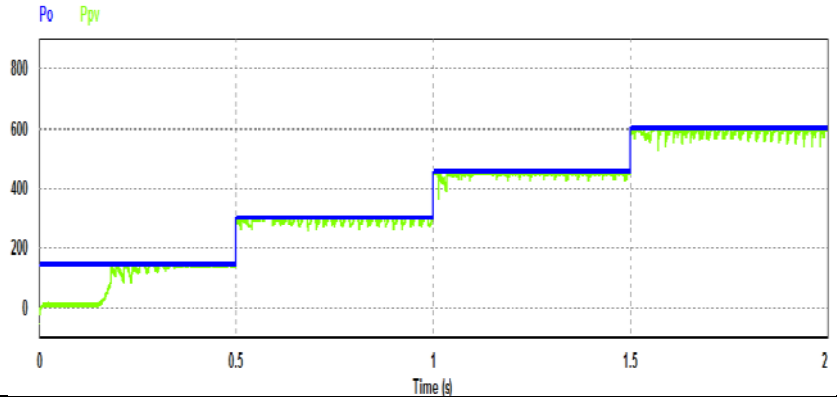

Fig. 5 Maximum power tracking.

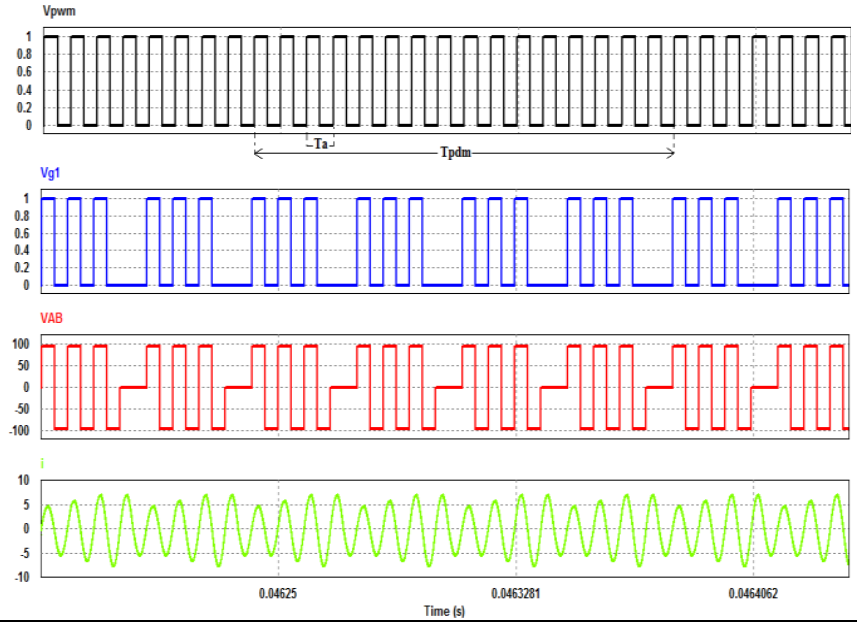

Fig. 6. 500 W/m2, PWM, gate control signal, *VAB* voltage and resonant current.

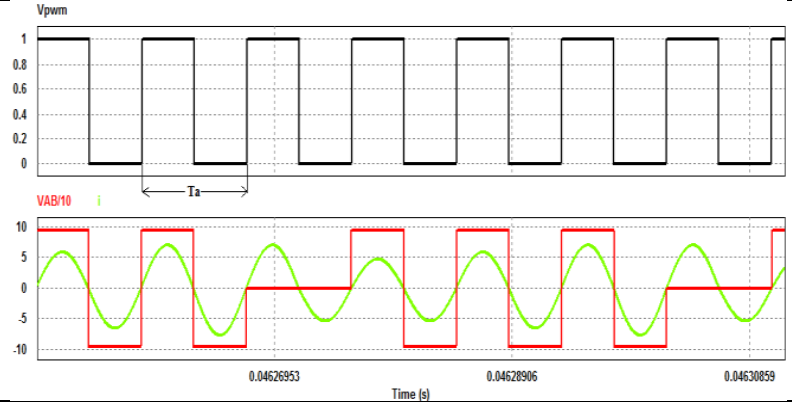

Fig. 7. PWM signal, *VAB* voltage and resonant current

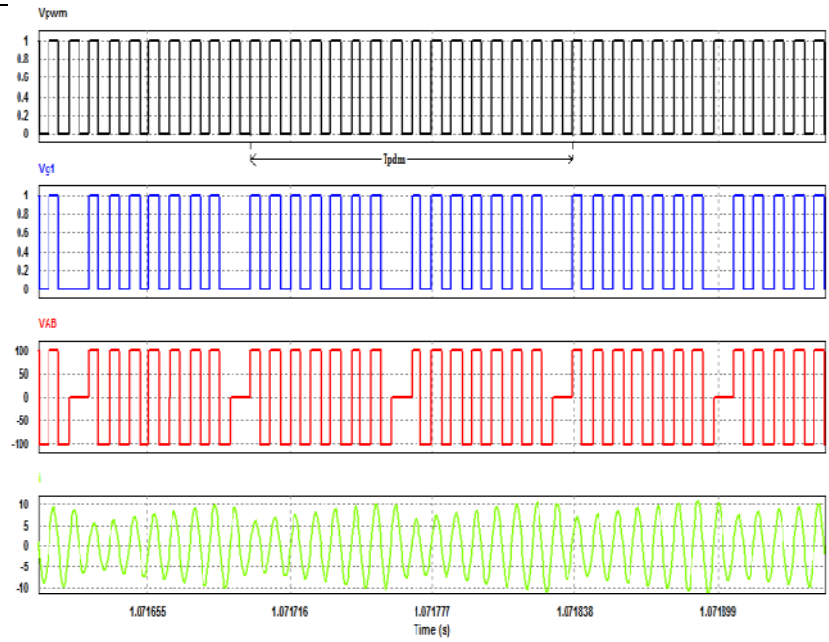

Fig. 8. 750 W/m2, PWM, gate control signal, *VAB* voltage and resonant current.

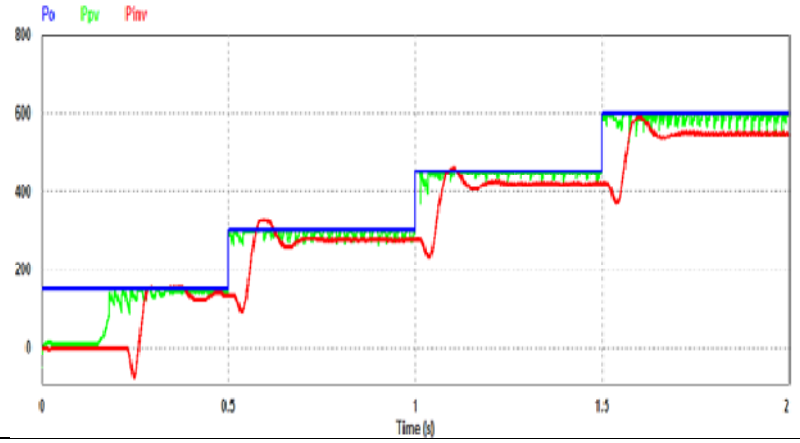

Fig. 9. PV panel power, power with MPPT algorithm and the output power of the system.

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RESEARCH ARTICLE

Phytochemical Screening and DPPH Radical Scavenging Activity of *Clinacanthus nutans* using Kidney Dysfunction and Molecular Docking Studies

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ABSTRACT

Chronic renal disease is another name for kidney dysfunction. It happened as a result of the kidneys losing their function over time. According to a recent estimate, chronic renal disease affects 65000 people each year. It is also a major concern throughout the rest of the world. CKD progression is linked to a slew of serious consequences, including a higher risk of cardiovascular disease, hyperlipidemia, anaemia, and metabolic bone disease. To reduce morbidity and mortality, CKD patients should be screened for the presence of these comorbidities and given the best treatment possible. To achieve this goal, a multidisciplinary strategy is required. *Clinacanthus nutans* Lindau is a member of the Acanthaceae family and is known as snake grass. In traditional herbal therapy, this plant is used to cure skin rashes, insects, and snake bites, among other things. Interestingly, some traditional physicians in the country's rural south advocated taking *Clinacanthus nutans* extract to treat kidney disease by lowering creatinine levels and increasing glomerular filtration rate. However, the scientific validity of this recommendation has not been established. As a result, this research was carried out in order to test and scientifically corroborate the validity of this traditional medicine suggestion.

Keywords: *Clinacanthus nutans,* Kidney dysfunction, Phytochemical screening and Molecular docking.

INTRODUCTION

Chronic renal disease (CRD) is another term for chronic kidney disease (CKD). It happened as a result of the kidneys losing function over time. According to a recent estimate, chronic renal disease affects 65000 people per year. It is also a major concern on a global scale. CKD progression is linked to a slew of serious consequences, including an increased risk of cardiovascular disease, hyperlipidaemia, anaemia, and metabolic bone disease. To reduce morbidity and mortality, CKD patients should be evaluated for the presence of these comorbidities and given the best treatment possible. To accomplish this goal, a multidisciplinary strategy is required. The Acanthaceae family is a large global family with a strong presence in tropical and subtropical regions. They can be found in both the Old and New World's equinoctial zones, with a few species reaching as far north as southern Europe, Pennsylvania, and Japan, and as far south as the Cape of Good Hope and the southern coast of New Holland. [1]. The majority of them are epiphytes, tropical plants, shrubs, or twining vines. A few of them live in hotter climate. This family's species are primarily found in Indonesia and Malaysia, as well as Africa, Brazil, and Central America[2]. *Clinacanthus* is a genus of two species, *C. nutans* LINDAU and *C. siamensis* BREM, that belongs to the Acanthaceae family. Both species are tiny shrubs that can be found all over Southeast Asia[3]. Flavonoids, stigmasterol, -sitosterol, lupeol, betulin, C-glycosyl flavones, vitexin, isovitexin, shaftoside, isomollupentin, 7-O—glucopyranoside, orientin, isoorientin, monoacylmonogalactosylglycerol, and sulfur-containing glucosides are the main ingredients of *Clinacanthus nutans* [4]–[6]. *Clinacanthus nutans* was once used to treat inflammation and viral infection[7]–[9]. *C. nutans* is traditionally used in Thailand to treat skin rashes, snake and insect bites, diabetes mellitus, and diarrhoea [10], [11].

MATERIALS AND METHODS

Chemicals

The chemicals were purchased from Loba Chem Pvt. Ltd and Rankem India.They were: Concentrated hydrochloric acid, concentrated sulphuric acid, Chloroform, Ferric chloride, Potassium hydroxide, Glacial acetic acid, Copper sulphate, sodium hydroxide. The solvents were ACS reagent grade or higher.

Materials

Clinacanthus nutans leaves were collected from siruseri surroundings of Chennai, Tamil Nadu, India. The leaves were cleaned and sundried. Dried samples were finely powdered and kept in airtight bottle at refrigerator for further analysis.

Preliminary phytochemical screening

The preliminary qualitative phytochemical screening of powder extract of *Clinacanthus nutans* was done to find out the different phytochemical constituents such as alkaloids, phenolic compounds, flavonoids, saponins, tannins, glycosides, steroids, and terpenoids using standard methods[12].

Hager's test for alkaloids determination

About 50 mg solvent-free powder was stirred with 5 ml of dilute hydrochloric acid and filtered. To the filtrate, 2 ml of Hager's reagent (aqueous solution of picric acid) was added. A yellow precipitate appears that indicates the presence of alkaloids[13].

Ferric chloride test for phenolics determination

About 50 mg of the powder was dissolved in 5 ml of distilled water. To this, a few drops of 5% neutral ferric chloride solution was added. Phenolic compounds were indicated by the presence of dark green colour [14].

Potassium hydroxide test for tannins determination

The powder extract (500 mg) was added into 10 ml of freshly prepared 10% potassium hydroxide (KOH) in a beaker and shaken to dissolve. A dirty precipitate formation indicated the presence of tannins in the sample[15].

Alkaline reagent test for flavonoids determination

An aqueous solution of the powder was treated with a 10 % ammonium hydroxide solution. The appearance of bulky white precipitate indicated the presence of flavonoids[16].

Liebermann-Burchard reaction for terpenoids determination

About 50 mg of the powder was added to 1mL of chloroform, was mixed, and then added to acetic anhydride followed by concentrated sulphuric acid from the sides of the tubes. The appearance of red and bluish-green colour indicated the presence of steroids and triterpenoids.

Frothing test for saponins determination

The powder extract (50 mg) was diluted with distilled water and made up to 10 ml. The suspension was shaken in a graduated cylinder for 15min; an increase in the layer of foam indicated the presence of saponins[17].

Borntrager's test for glycosides determination

About 50mg of powder was hydrolyzed with concentrated hydrochloric acid for 2h on a water bath and filtered. To 2 ml of filtrate, 3 ml of chloroform was added and shaken. The chloroform layer was separated and 10% ammonia solution was added to it. The formation of pink colour indicated the presence of glycosides.

Salkowski test for steroids determination

2 ml of chloroform and 1ml concentrated sulphuric acid were added to 10 drops of the powder mixed with isopropyl alcohol, slowly until double phase formation. The presence of a dish-brown colour in the middle layer marks the presence of a steroidal ring.

Determination of total phenolics

The quantitative estimation of phenolics in the extract of *Clinacanthus nutans* was determined based on the standardized method[18]. About 0.5 ml of 1N Folin-Ciocalteu reagent and 2.5 ml of 20% sodium carbonate solution were added, and then the volume was made up to 10 ml with water. Followed by 40min dark incubation and the absorbance were recorded at 725nm against blank for the estimation of phenolics. The results were based on the calibration curve: y = 0.029x – 0.065, R2 = 0.955 where x was the absorbance and y was the Gallic acid equivalents (mg/g) and were expressed in terms of milligrams Gallic acid equivalents (GAE) per gram of extract.

Determination of Total flavonoids

The total flavonoid in the extracts is estimated by the general procedure [19]. To each 300 µl of *Clinacanthus nutans* powder extracts 2 ml of distilled water was added followed by150 µl of NaNO2. The contents of the tubes were subjected to incubation for 6 min at room temperature. After incubation 150 µl of AlCl3 (10%) was added and incubated again for 6 min at room temperature. Then 2 ml of 4% NaOH was added, vortexed well, and kept at room temperature for another 15 min. The absorbance of pink colour thereby developed was read spectrophotometrically at 510 nm. The results were based on the calibration curve: y = 0.002x + 0.006, R2 = 0.992 where x was the absorbance, and y was the rutin equivalents (mg/g) and the results were expressed in terms of milligrams rutin equivalents per gram of extract.

***In vitro* Antioxidant assay**

DPPH radical scavenging activity

The radical scavenging activity of the extract was determined by the standardized method of DPPH radical scavenging activity[20]. A methanol solution of the sample extract at various concentrations was added to 5 ml of 0.1 mm methanolic solution of DPPH and allowed to stand for 20 min at 27°C. The absorbance of the solution was read at 517 nm using a spectrophotometer. Methanol was served as blank and a solution without powder extract of *Clinacanthus nutans* served as the negative control. The mixture of methanol, DPPH, and standard rutin served as the positive control. The radical scavenging ability of the extract is expressed by IC_{50}value of the extract.

Formula

$R^2 = Y=MX+C$

$$\% \text{ of inhibition} = \frac{\text{Control OD} - \text{Sample OD}}{\text{Control OD}} \times 100$$

Molecular docking analysis

Protein sequences

Serine pyruvate aminotransferase protein was retrieved from the online database of SWISSPROT. It obtained the entry keyword of kidney dysfunction protein AGXT and searched it in the entire database. There are different numbers of AGXT protein sequence were shown. Among that the human AGXT AGT1 protein was retrieved as FASTA format and it was used for the further computational analysis.

Primary structure prediction

For physiochemical characterization, theoretical isoelectric point (PI), molecular weight, total number of positive and negative residues, extinction coefficient, Half-life, instability index, aliphatic index and grand average of hydropathy (GRAVY) were computed using the Expasy protparm server.

Secondary structure prediction

Secondary structure of this protein was predicted using the FASTA sequences of protease and predicted using SOPMA and SOPM.

Transmembrane region identification

The transmembrane region of AGXT protein was examined by SOSUI server. The evaluated transmembrane region was analysed and visualized by Pepwheel using EMBOSS 2.7 suit.

Homology modeling and validation

The protein sequence was subjected for comparative homology modeling via Swiss model and evaluate by Rampage online server. The protein was validated by using online server Prochek and WHAT IF. The Swiss model performs the sequence alignments and searches for the putative template protein for generating the 3D model.

Sequence subjected for modeling

>target

>sp|P21549|SPYA_HUMAN Serine--pyruvate aminotransferase OS=Homo sapiens OX=9606 GN=AGXT PE=1 SV=1

MASHKLLVTPPKALLKPLSIPNQLLLGPGPSNLPPRIMAAGGLQMIGSMSKDMYQIMDEIKEGIQYVFQTRNPLTLV
ISGSGHCALEAALVNVLEPGDSFLVGANGIWGQRAVDIGERIGARVHPMTKDPGGHYTLQEVEEGLAQHKPVLLF
LTHGESSTGVLQPLDGFGELCHRYKCLLLVDSVASLGGTPLYMDRQGIDILYSGSQKALNAPPGTSLISFSDKAKKK
MYSRKTKPFSFYLDIKWLANFWGCDDQPRMYHHTIPVISLYSLRESLALIAEQGLENSWRQHREAAAYLHGRLQAL
GLQLFVKDPALRLPTVTTVAVPAGYDWRDIVSYVIDHFDIEIMGGLGPSTGKVLRIGLLGCNATRENVDRVTEALR
AALQHCPKKKL

GC-MS analysis

The Extract of *Clinacanthus nutans* undergoes with GC-MS analysis and identified the distinguished compounds.

Ligand retrieved

The screened compounds were retrieved from the pubchem compound[21] and used for the further studies.

Receptor retrieved

The receptor of AGXT protein factor was downloaded from the PDB [22] and the PDB ID is 1J04.

Docking studies

Docking calculations were carried out using Docking Server [23]. Gustier partial charges were added to the ligand atoms. Non-polar hydrogen atoms were merged, and rotatable bonds were defined. Docking calculations were carried out on *alpha amyrin and beta amyrin.pdb* protein model. Essential hydrogen atoms, Kollman united atom type charges, and salvation parameters were added with the aid of AutoDock tools. Affinity (grid) maps of ×× Å grid points and 0.375 Å spacing were generated using the Autogrid program[24]. AutoDock parameter set- and distance-dependent dielectric functions were used in the calculation of the van der Waals and the electrostatic terms, respectively. Docking simulations were performed using the Lamarckian genetic algorithm (LGA) and the Solis & Wets local search method[25]. Initial position, orientation, and torsions of the ligand molecules were set randomly. All rotatable torsions were released during docking. Each docking experiment was derived from 10 different runs that were set to terminate after a maximum of 250000 energy evaluations. The population size was set to 150. During the search, a translational step of 0.2 Å, and quaternion and torsion steps of 5 were applied.

RESULTS AND DISCUSSION

Physiochemical analysis of *Clinacanthus nutans*

Natural products or compounds derived from natural products continue to play a major role in drug development process. Natural products have been the source of most of the active ingredients that are used in modern medicine[26]. More than 80% of the material used to make drugs are natural products or inspired by natural compounds. Physiochemical standardization has become necessary steps in quality control of drugs in both single as well as compound formulations. The effectiveness of the drug is mainly based on its physical and chemical properties hence, the determination of physiochemical characters for accuracy of a drug is essential. It is also helps in the characterization of constituents that often lead to establish the mechanism of action of the drug. In the present study, physiochemical evaluation such as solubility, pH values were determined and the results were expressed in the (Table 1). The methanolic extract of *Clinacanthus nutans* easily soluble in alcohol, acetone, DMSO. It is insoluble in Ethyl acetate, chloroform, and hexane. The pH of methanolic extract of *Clinacanthus nutans* was 6.8. The color of the sample is greenish yellow. The results obtained from the physiochemical parameters may be used for quality evaluation and standardization of the compound formation of methanolic extract of *Clinacanthus nutans*. Thus, the data generated in this analysis could be utilized as a reference for setting limits for the reference standards for the quality control and quality assurance of these drugs.

Qualitative and quantitative phytochemical analysis of *Clinacanthus nutans*

Clinacanthus nutans is being used as the traditional medicine not only in different parts of India but also throughout the world for the time immemorial. The result of the phytochemical screening of methanolic extract of this plant directly correlates with the facts of using this plant as an ethnomedicine. We detected the presence of various secondary metabolites like alkaloids, phenols, tannins, steroids, terpenoids, flavonoids, and saponins. Glycosides, Flavanol glycosides and Cardiac glycosides were found to be absent in these extract. The qualitative phytochemical analysis of methanolic extract of *Clinacanthus nutans* was performed and the results were show in (Table 2). The

results of quantitative phytochemical analysis were represented in (Table 3). The estimation of Phenol content was found to be y = 0.029x – 0.065, R^2 = 0.955 Gallic acid equivalent. The total flavonoids content of the extract were y = 0.002x + 0.006, R^2 = 0.992 mg of quercetin equivalent/ml of methanolic extract of the sample with reference to standard curve for phenol (y=0.0001x, r^2=0.997), flavonoids (y=0.005x, $r^2$0.989) respectively. In this quantitative phytochemical analysis of methanolic extract of *Clinacanthus nutans* revealed that the extract has more phenolic and less flavonoids respectively.

Phytochemicals are the core of phytomedicines; their therapeutic efficiency directly correlates with the presence of various phytochemicals. In this study, we have identified and quantified the major phytochemicals present in the aqueous extract of *Clinacanthus nutans*. Alkaloids are those which naturally occurs as chemical compounds in plants parts that often have pharmacological effects. Phenolic compounds tend to show antioxidant properties as oxygen scavengers, peroxide decomposers, metal chelating agent, and free radical inhibitors; also possess anti-bacterial, anti-viral, anti-tumor, anti-mutagenic and cardio protective properties[27]. Tannins are known to be the high molecular weight phenolic that precipitate protein[28]. Flavonoids are capable of scavenging oxygen-derived free radicals also possess anti-inflammatory, anti-allergic, anti-viral, and anti-carcinogenic properties[29]. Saponins are the bioactive compounds with both biological and pharmacological properties that naturally occur in plants as triterpenes or steroid glycosides [30]. Terpenoids which are plant-basedcompounds have been used in the food traditionally; also act as a source primarily in pharmaceutical and chemical industries. They are recently been used in developing biofuel products as well [31]. Plant steroids have antibacterial properties; they possess many medicinal, pharmaceutical and agrochemical activities and are known to enhance the immune response as well [32]. The presence of these biologically active compounds in the leaves has several properties especially by fighting against pathogens they prove to possess antimicrobial ability, antioxidant capacity by scavenging the harmful free radicals, therapeutic potential and serve to be a better nutraceutical.

The polyphenolic constituents possess several activities such as free radical scavenging, anti-inflammatory, anti-carcinogenic, antimutagenic, anti-microbial etc. The substantial quantity of those compounds likely aids better for the antioxidative and antimicrobial potential. Total polyphenolic content plays a significant role in antioxidation as well as important biological function of the plant[33]. Flavonoids and tannins are the phenolic compounds that belong to the chief group of plant phenolics, they are free radical scavengers and are primary antioxidants [34]. Since these compounds were found to be present in the fruit extracts it might be responsible for the potent antioxidant capacity in scavenging the free radicals.

***In vitro* antioxidant activity**

Antioxidants are the organic substances that are highly utilized through natural sources which is also a combination of complex phytocompounds. Due to extreme generation of oxidative stress by prooxidants, a condition is developed where the cellular molecules such as proteins, lipids, and nucleic acids suffer oxidative damages and may cause tissue disruption [35], [36]. So the antioxidants found in the leaf of *Clinacanthus nutans* can play a vital role in stabilizing the free radicals. The antioxidant capacity of the leaf extract of *Clinacanthus nutans* were studied to find the ability of free radical scavenging property (Table x). The DPPH scavenging activity was studied by calculating the IC50 values of the extract. Based on the results it was found that the minimum IC50 value was in the methanolic extract (10 µg/mL) that proved to show the higher ability to scavenge the DPPH radical. DPPH radical scavenging activity is the convenient, easiest and fast method for screening antioxidants in plant extract[37].

Molecular Docking

Primary structure analysis

The Serine pyruvate aminotransferase protein was retrieved from SWISSPROT in FASTA format. The primary physiochemical parameter was performed and amino acid composition was identified (Table 1 and Table 2). The result shows that the Serine pyruvate aminotransferase protein was composed of 22 aminoacids with different ratios. Among that Leucin content was more (13.5%) that indicate the hydrophobic nature of protein because it has an

aliphatic isobutyl side chain and also essential aminoacid. This indicates the sequence length is 392, and the molecular weight of protein was found to be 43009.92 the protein has 8.61 isoelectric points that represent the protein is basic in nature and it will help to purify the protein molecule. The number of negative charged residues (Asp + Glu) is 36 and number of positive charged residues (Arg + Lys) is 40. The extinction coefficient was 47245 at 280 nm; it may be probable to avoid interference of other substances. The evaluated value used to determine the quantification of protein – protein or protein – ligand interactions. The quantitative measurement of dynamic equilibrium based on the half-life time. The Serine pyruvate aminotransferase protein has 30 hours in mammalian reticulocytes; in yeast have 20 hours and 10 hours in E.coli. The stability of protein was determined by using the instability index (36.94). The aliphatic index characterize that the volume of protein occupied by aliphatic chains (Alanine, Valine, Isoleucine and Leucine), Serine pyruvate aminotransferase protein have 99.03 that denoted unstable in high thermal conditions. Grand Average Hydropathicity denoted that the hydrophobicity of aminoacid residues. Here Serine pyruvate aminotransferase protein has -0.062 had a reasonable interaction with water molecule. The protein molecule has 4 different atoms such as C, H, N, O and S, molecular formula was $C_{1933}H_{3076}N_{528}O_{547}S_{17}$.

Secondary structure of protein

The secondary structure of Serine pyruvate aminotransferase protein was predicted by using SOPMA and SOPM (Table x). The protein was α helix with other structures such as extended stand, β turn and random coil. Presents the comparative analysis of SOPMA and SOPM. From which it is clear that random coil is mostly present, when the structure was predicted both by SOPMA and SOPM, followed by extended strand and alpha helix. So this protein is stable in nature.

Protein structure validation

Ramachandran plot

The predicted Serine pyruvate aminotransferase protein structure was validated by using Ramachandran plot using PROCHECK software that shows the protein molecule contains 322 residues in that 311 aminoacid most favored region, 11 aminoacid additionally allowed and 0 aminoacid generally and disallowed region. The results are shown in (Fig 3.1). WHATIF shows that i.e. Z-score of protein is -1.96.

Docking

Serine pyruvate aminotransferase protein (Fig 3.2) and ligands (isolated compounds of *Clinacanthus nutans*) Table 4 were subjected to docking studies by using online Auto dock server. The software used to runs 10 docking and were shown in Table 5. The 3D structure of Serine pyruvate aminotransferase protein (PDB id: 1J04) were optimized to achieve minimal potential energy using molecular docking server. The minimization values are summarized. Docking simulation of 10 runs of plant compound Lupeol, Beta sitosterol, and Betuline was performed for a set of catalytic active site of Serine pyruvate aminotransferase protein (Fig 3.3). The best docked conformation was selected based on lowest docking energy and binding free energy. Docking score is a measure of interaction of the ligand to the active site of the target. More negative values indicate more effective stable conformation of the bound ligand target. 1J04 is the Serine pyruvate aminotransferase protein known as AGXT AGT1 protein,

Docking simulation of Lupeol into Serine pyruvate aminotransferase protein (PDB id: 1J04) resulted in the formation of amino acid residues PHE 28 and ALA 18. The polar interactions are ASP 30, ASN 116 and other interactions are LYS 117, LYS 16, LYS 147, VAL 29, ASP 119 and SER 17. The docking score of the complex were -7.13 kcal/mol. The Beta sitosterol into Serine pyruvate aminotransferase protein resulted in the formation of amino acid residues in hydrophobic interactions are PRO 34, TYR 32, PHE 28, VAL 29, ALA 18, and ALA146. The polar bonds are THR 35, ASP 30, and ASP 119. The hydrogen bonds are SER 17 and other interactions are LYS 117, ASN 116 respectively. The docking score of the complex were -7.57 kcal/mol. The Betulin into Serine pyruvate aminotransferase resulted in the formation of THR 35 and ASn 116 are polar bond interaction. Hydrophobic interactions are PHE 28 and hydrogen bonds are SER 17. The other interactions are LYS 117, TYR 32, LYS 147, ALA 18, ASP 119. The docking score of the complex were -6.43 kcal/mol respectively.

CONCLUSION

C. nutans is widely used as a traditional medicine in numerous Asian nations. All parts of this plant have been employed in the treatment and prevention of a variety of issues, including viral infection, cancer, and insect bite-induced skin irritation. The principal bioactive chemicals in this plant are flavonoids, and various preparations have been proven to exhibit biological action. This plant's lower toxicity suggests that it could be used as a therapeutic cure for a variety of diseases.

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None

Conflicts of Interest

None

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Table 1: Physiochemical properties of aqueous extract of *Clinacanthus nutans*

S. No	Characteristics	Observation
1	Color	Greenish yellow
2	Solubility in water	Easily soluble in water
3	Solubility in alcohol	Easily soluble in alcohol
4	Solubility in acetone	Easily soluble in acetone
5	Solubility in DMSO	Easily soluble in DMSO
6	Solubility in ethyl acetate	Insoluble
7	Solubility in chloroform	Easily soluble in chloroform
8	Solubility in hexane	Easily soluble in hexane
9	pH	6.8

Table 2. Preliminary phytochemical screening of *Clinacanthus nutans*

S.No	Phytochemical constituents	Presence or absence
1	Alkaloids	++
2	Phenolic compounds	++
3	Tannins	+
4	Flavonoids	+
5	Terpenoids	+
6	Steroids	+
7	Glycosides	-
8	Flavanol glycosides	-
9	Cardiac glycosides	-
10	Saponins	+
11	Phytosterol	+
12	Fixed oils and fats	+
13	Carbohydrates	+
14	Proteins	++
15	Amino acids	+

(+): presence of chemicals, (-): absence of chemicals or not detectable concentration, (+) < (++) < (+++): based on the intensity of characteristic.

Table 3. Quantitative phytochemical analysis of *Clinacanthus nutans*

Quantitative phytochemical analysis	
Phytoconstituents	**Percentage (%)**
Phenolics	68.32215
Flavonoids	4.805128

Table 4. DPPH assay (1, 1-diphenyl-2-picrylhydrazyl)

Sample	Conc (mcg/ml)	Absorbance	Control	% of inhibition	IC 50 % / ml
CN	10	0.471	0.998	52.80561	49.165
	10	0.512	0.998	48.69739	
	10	0.539	0.998	45.99198	

Table 5. Amino acid composition (%) of SPYA protein computed in protparam

Amino acids	Numbers	Percentage
Ala (A)	29	7.4%
Arg (R)	19	4.8%
Asn (N)	10	2.6%
Asp (D)	19	4.8%
Cys (C)	6	1.5%
Gln (Q)	17	4.3%
Glu (E)	17	4.3%
Gly (G)	37	9.4%
His (H)	13	3.3%
Ile (I)	22	5.6%
Lea (L)	53	13.5%
Lys (K)	21	5.4%
Met (M)	11	2.8%
Phe (F)	10	2.6%
Pro (P)	25	6.4%
Ser (S)	25	6.4%
Thr (T)	17	4.3%
Trp (W)	5	1.3%
Tyr (Y)	13	3.3%
Val (V)	23	5.9%
Pyl (O)	0	0.0%
Sec (U)	0	0.0%

Table 6. Parameters computed using Expasy's protparam tool

Name	Accession No	Sequence length	Mol. Wt	PI	-R	+R	EC	II	AI	GRAVY
SPYA	P21549	392	43009.92	8.61	36	40	47245	36.94	9.03	-0.062

Mol.wt – Molecular weight; PI – Isoelectric point; -R – number of negatively charged residues; +R – number of positively charged residues; EC – Extinction coefficient at 280nm; II – Instability index; AI – Aliphatic index; GRAVY – Grand average of hydropathicity.

Table 7. Secondary structure of SPYA protein by SOPMA and SOPM

Secondary structure	SOPMA	SOPM
Alpha helix (Hh)	156 is 40.31 %	136 is 34.69 %
3_{10} helix (Gg)	0 is 0.00 %	0 is 0.00 %
Pi helix (Ii)	0 is 0.00 %	0 is 0.00 %
Beta bridge (Bb)	0 is 0.00 %	0 is 0.00 %
Extended strand (Ee)	73 is 18.62 %	87 is 22.19 %
Beta turn (Tt)	29 is 6.63 %	40 is 10.20 %
Bend region (Ss)	0 is 0.00 %	0 is 0.00 %
Random coil (Cc)	135 is 34.44 %	129 is 32.91 %
Ambiguous states (?)	0 is 0.00 %	0 is 0.00 %
Other states	0 is 0.00 %	0 is 0.00 %

Table 8. Plant compounds identified by GC-MS

S. No	Name of the compound	Mol. Formula	Mol. Weight	Mol. Structure
1	Lupeol	$C_{30}H_{50}O$	426.7	
2	Beta sitosterol	$C_{29}H_{50}O$	414.7	
3	Betulin	$C_{30}H_{50}O_2$	442.7	

Table 9. Interacting residues responsible for docking

Docking result	Est. free energy of binding	Est. inhibition constant, Ki	vdW + Hbond + desolv Energy	Electrostatic Energy	Total Inter molecs. Energy	Frequency	Interact. Surface
Lupeol with 1J04	-7.13 kcal/mol	136.68 nM	-9.61 kcal/mol	-0.05 kcal/mol	-9.66 kcal/mol	100%	902.319
Beta sitosterol with 1J04	-7.57 kcal/mol	2.82 uM	-8.77 kcal/mol	-0.29 kcal/mol	-9.06 kcal/mol	40%	796.988
Betulin with 1J04	-6.43 kcal/mol	149.40	-5.15 kcal/mol	-0.07 kcal/mol	-5.22 kcal/mol	50 %	547.665

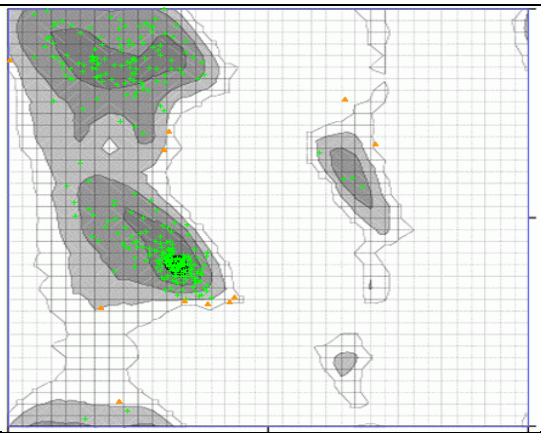


Fig 2. Ramachandran plot

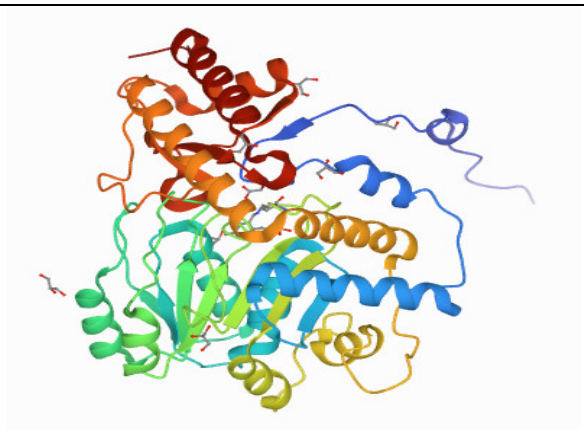
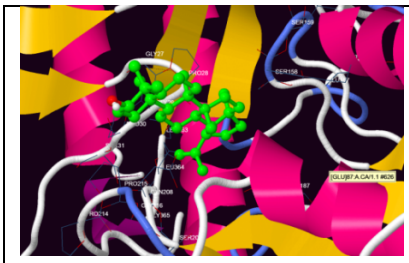


Fig 2. SPYA protein

		
Lupeol with 1J04	**Beta sitosterol with 1J04**	**Betuline with 1J04**
Fig. 3. Docking interactions		

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RESEARCH ARTICLE

An Analysis of Frequent Pattern Mining Techniques at Multiple Time Granularities

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ABSTRACT

Frequent pattern mining is an process of finding the repeated items from the given input database to support various domains such as online marketing, digital evaluation and so on. With the growing nature of internet technologies, amount of data also increased which is difficult to handle in real time. For better decision making, it is required to extract frequent patterns from the multiple time granularities. There is various research techniques has been introduced earlier for the frequent pattern mining. The main purpose and goal of this analysis work is to discuss and analyse about the different frequent pattern mining techniques introduced by the various authors. This analysis work provides the detailed overview of the research techniques in terms of their working procedure. And also this analysis work provides the discussion of the different research techniques based on merits and demerits. This analysis work provides the comparison analysis of existing frequent pattern mining techniques to find the better techniques which can ensure the accurate frequent pattern mining technique.

Keywords: Frequent pattern, multiple time granularity, digital marketing, growing data, developing technologies

INTRODUCTION

Frequent pattern mining is a core data mining operation and has been extensively studied over the last decade. Recently, mining frequent patterns over data streams have attracted a lot of research interests. Compared with other

streaming queries, frequent pattern mining poses great challenges due to high memory and computational costs, and accuracy requirement of the mining results. As the technologies are growing faster, generation of data also growing rapidly. More popular applications such as power consumption, sensor technologies, and so on generate more volume of data dynamically which is more difficult to handle [1]. Finding frequent and interesting patterns from the time granular streaming data is more difficult [2]. The complete frequent pattern mining task can be accomplished by handling both frequent and infrequent items from the database. If infrequent items are not stored properly this cannot be retrieved later for the future requirement. But storing complete information about both frequent and infrequent items is also impossible [3].

Frequent pattern mining in the streaming data can be performed by extracting the useful and interesting patterns from the data for the different time periods [4]. This extracted information from the different time periods can be merged together for the later purpose. This process needs to be performed repeatedly in different time granularities to extract the complete information from the streaming data [5]. There are only few works only are introduced for handling the streaming data for the frequent pattern mining. Existing works, process the data with limited window size only which would not be suitable for the streaming data. The main contribution of this research work is to study the different existing research works which attempts to mine the frequent pattern from the streaming data. This analysis work attempts to study various methodologies whose main goal is to mine the frequent patterns in different time granularities over dynamic streaming data. And also this research work would generate comparison analysis of different existing technologies to predict the better method which can produce accurate mining result.

The overall organization of the research work is given as follows: In this section, introduction about the frequent pattern mining, and the need of frequent pattern mining is discussed. In section 2, analysis of different frequent pattern mining techniques from the different time granularities is discussed in detailed. In section 3, comparison analysis of the frequent pattern mining techniques is done in terms of merits and demerits. In section 4, numerical analysis of the frequent pattern mining techniques is done to find the better techniques from the existing works. Finally in section 5, conclusion of the analysis work is provided in terms of different merits and numerical outcomes.

ANALYSIS OF FREQUENT PATTERN MINING TECHNIQUES

In this section discussion of the different time granularity based frequent pattern mining techniques are introduced and discussed. Deypir & Sadreddini (2012) introduced the dynamic layout of sliding window to perform the frequent pattern mining over streaming data. This is done by adapting the window adjustment technique which will maintain the require list of type conversion and update the memory usage in terms of concept change. The main goal of this research work is to select the optimal window size based on which required item list can be maintained. Thus the frequent pattern mining can be performed effectively with increased accuracy level. Ahmed et al (2012) introduced two algorithms namely High Utility Stream Tree (HUS-Tree) and High utility pattern mining over stream data (HUPMS) for extracting the high utility item sets from the streaming data. This work considers only important information for processing which will then be utilized to extract high utility items. This work also reduces the memory usage by limiting the window size which also tends to lesser execution time. This work follows the incremental algorithm for extracting the high utility item sets from the dataset.

Nori et al (2013)proposed Sliding window based algorithm for extracting the closed frequent item sets. This is done by analysing and storing the transactions in the memory in order to predict the frequent close itemsets. This work updates the memory periodically by removing the old frequent close itemsets and storing the new frequent close itemsets. This method proved woks better on both real time and synthetic datasets. Lee et al (2014) introduce weighted maximal frequent pattern mining over data streams based on sliding window model (WMFP-SW) for extracting the frequent patterns efficiently. The main contribution of this research work is to assign the weight value for the itemsets, thus the more important itemsets can be highlighted which will make easier to extract the frequent patterns. The evaluation of this research work proves that the proposed weight based techniques ensures the better performance in terms of runtime, memory usage and scalability.

Chen & Chen (2014)introduced sequent pattern mining technique for the uncertain data streams for extracting the most useful information. This method processes the uncertain data effectively by compressing and then storing the time. This work adapts the sequence items from compressed database which will be processed towards better efficiency. These woks generate the sequential chunks for storing and retrieving the acts efficiently. Silva & Antunes (2015)attempted to perform multi relational pattern mining by introducing the method namely Star FP Stream. The main goal of this research work is to extract the multi relational patterns from the streaming data with the consideration of original structure. This research work extracts the patterns from the original data by covering all dimensions and businesses. The simulation results conducted proved to provide the better outcome over health care and sales domain. Yun et al (2014) introduced Maximal frequent pattern mining with weight conditions (MWS) for extract the frequent patterns with the consideration of weight conditions. This research work attempts to avoid the processing overhead while extracting the frequent patterns from the streaming data. The performance analysis of this research work proved the enhanced reliability by extracting the mining results from the databases with the consideration of weight conditions.

Ryang& Yun (2016) introduced tree based data structure to mine the high utility item sets from the streaming data. The main contribution of this research work is to extract the high utility item sets from the database with reduced over estimated utility value. This research work updates the database with up to date information to ensure the proper and accurate high utility mining outcome. The performance analysis proved that tree based method outperforms the sliding window based techniques will lesser run time and memory utilization. Yun et al (2018) introduced Damped window based high average utility pattern miningto support streaming data with batch operation. This research work performs utility mining on the data that are collected from heart beat sensor. This research work performs well on continuous, unbounded stream data with the higher influence on older data. Thus it leads to better outcome with lesser run time and memory utilization. The performance analysis of the research work tends to prove, it supports highly scalable datasets with lesser run time and memory utilization.

Fernandez-Basso et al (2019)introduced sliding window based frequent itemset mining technique for supporting highly reliable mining outcome with increased tendencies. The main goal of this research work is to support the big data technology with the help of spark streaming framework. The performance analysis of this research work proved that the proposed technique can ensure th optimal outcome with increased scalability and algorithm speed. Cai et al (2020) attempted to predict the outliers in terms of frequent pattern mining over uncertain weighted data streams. This is done by introducing the method namely UWFB-outlier technique. This research work mine the patterns by considering the factors namely deviation degree of each transaction in the database. This research technique will find the more deviated transaction from the input database which will be resultant as outliers. The analysis of this research work proved that the proposed method tends to find the frequent patterns from data stream with lower time cost.

COMPARISON ANALYSIS

In this section comparison analysis of the existing research techniques is done in terms of merits and demerits. The following table 1 provides the comparison technique along with dataset used in each research work.

NUMERICAL ANALYSIS

In this section, comparison analysis is carried out between five existing research works namely Maximal frequent pattern mining with weight conditions (MWS), Tree based data structure (TDS), Damped window based high average utility pattern mining (DWHUPM), Sliding window based frequent itemset mining technique (SWFIM) and UWFB-outlier technique. The performance metrics that are considered in this research method for the evaluation of the proposed and existing research method are “Accuracy, Precision, Recall, F-measure”.

Accuracy

Accuracy is the most intuitive performance measure and it is simply a ratio of correctly predicted observation to the total observations.

Accuracy = (TP+TN) / (TP+FP+FN+TN)

From this comparison it can be proved that the UWFB shows 6% increased accuracy then SWFIM, 10% increased accuracy than DWHUPM, 24% increased accuracy than TDS and 26% increased accuracy than MWS.

Precision

Precision is the ratio of correctly predicted positive observations to the total predicted positive observations. High precision relates to the low false positive rate.

Precision = TP/TP+FP

From this comparison it can be proved that the UWFB shows 14% increased precision then SWFIM, 22% increased precision than DWHUPM, 25% increased precision than TDS and 56% increased precision than MWS.

Recall

Recall is the ratio of correctly predicted positive observations to the all observations in actual class - yes.

Recall = TP/TP+FN

From this comparison it can be proved that the UWFB shows 6% increased recall then SWFIM, 14% increased recall than DWHUPM, 17% increased recall than TDS and 39% increased recall than MWS.

F-Measure

F1 Score is the weighted average of Precision and Recall. Therefore, this score takes both false positives and false negatives into account. Intuitively it is not as easy to understand as accuracy, but F1 is usually more useful than accuracy, especially if you have an uneven class distribution. Accuracy works best if false positives and false negatives have similar cost. If the cost of false positives and false negatives are very different, it's better to look at both Precision and Recall.

F1 Score = 2*(Recall * Precision) / (Recall + Precision)

From this comparison it can be proved that the UWFB shows 9% increased recall then SWFIM, 22% increased recall than DWHUPM, 27% increased recall than TDS and 32.5% increased recall than MWS.

CONCLUSION

This analysis work provides the detailed overview of the research techniques in terms of their working procedure. And also this analysis work provides the discussion of the different research techniques based on merits and demerits. This analysis work provides the comparison analysis of existing frequent pattern mining techniques to find the better techniques which can ensure the accurate frequent pattern mining technique. The overall analysis of this research work proved that the UWFB method provides better outcome than the other methodologies in terms of accurate frequent mining outcome.

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Table 1.Comparison analysis of frequent pattern mining techniques

S.No	Author	Method	Dataset	Merits	Demerits
1	Deypir & Sadreddini (2012)	Dynamic layout of Sliding Window (DLSW)	Kosarak, Connect-4	Lesser run time Efficient memory usage Minimum support threshold	Higher computational complexity
2	Ahmed et al (2012)	HUS-Tree HUPMS	IBM synthetic dataset	Lesser run time Lesser memory usage Efficient for interactive mining	Varying window size cannot be adapted dynamically

3	Nori et al (2013)	Sliding window based algorithm	BMS webview-1 BMS webview -2 GAZ	Lower memory consumption Requires smaller execution time Suitable for high speed unbounded transactional data streams	Longer window size delimits the amount of data handling whereas lesser window size extends the execution time
4	Lee et al (2014)	Weighted maximal frequent pattern mining over data streams based on sliding window model (WMFP-SW)	Accidents Pumsb Retail Mushroom Tal.bNc	Lesser run time Increased scalability Lesser memory usage	Weight assignment will be difficult with lesser knowledge about dataset
5	Chen & Chen (2014)	Sequent pattern mining technique	IBM Almaden Research centre dataset	Effective mining outcome Increased accuracy level Lesser run time	More processing overhead
6	Silva&Antunes (2015)	Multi relational pattern mining	Hepatitis dataset	Accurate pattern mining outcome Increased precision Increased recall	Its required to have higher domain knowledge for processing
7	Yun et al (2014)	Maximal frequent pattern mining with weight conditions (MWS)	Accidents dataset Pumsb Retail Mushroom	Lesser run time Efficient memory usage Increased scalability	Strong correlation based frequent pattern mining
8	Ryang& Yun (2016)	Tree based data structure	Accident Connect Retail	Lesser run time Lesser memory consumption Less processing overhead	Complex algorithmic structure
9	Yun et al (2018)	Damped window based high average utility pattern mining	Heart beat sensors	Highly scalable Lesser run time Better memory utilization	This research work doesn't focus on reliable pattern extraction
10	Fernandez-Basso et al (2019)	Sliding window based frequent itemset mining technique	Resilient distributed dataset	High algorithm speed Increased scalability Lesser run time	Increased co-occurrence in dataset will lead to reduce mining performance
11	Cai et al (2020)	UWFB-outlier technique	Synthetic dataset Lymphography Heart Satimage-2	Lower time cost Faster detection of outlier	Does not support high scale of data

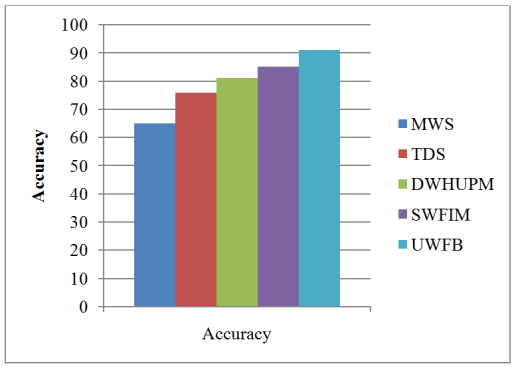

Figure 1. Accuracy comparison

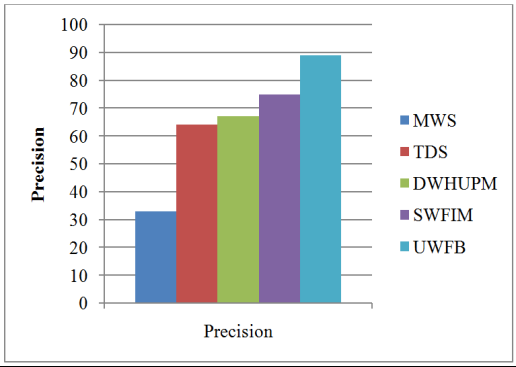

Figure 2. Precision comparison

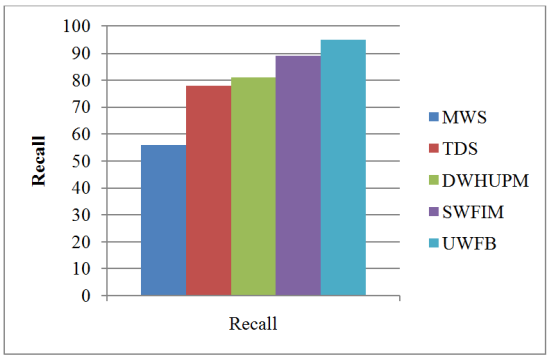

Figure 3. Recall comparison

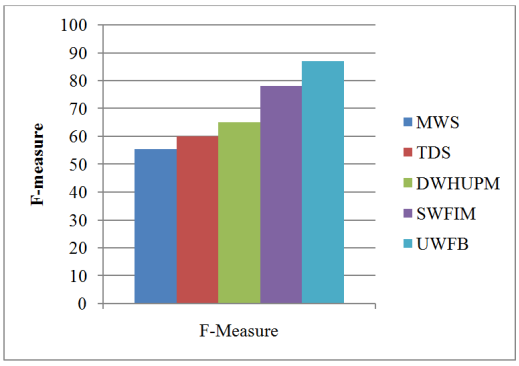

Figure 4. F-Measure comparison

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RESEARCH ARTICLE

Effect of Mulligan's Traction Straight Leg Raising with Kinesiotaping for Hamstring Tightness on Pain and Range of Motion in Mechanical Low Back Pain

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ABSTRACT

Low back pain has a strong relationship with the hamstring tightens. Although there were studies done on the management of hamstring tightness on the low back pain, the results are variable, so the purpose of the study is to identify the effect of mulligan's traction straight leg raise along with Kinesiotaping on low back pain with hamstring tightness. The experimental research involving fifty-six participants with low back pain and hamstring tightness was selected based on the predetermined selection criteria. They were all divided into two groups. Group A, twenty-eight [28] patients underwent Mulligan's Traction straight leg raise [TSLR] with Kinesiotaping [K-tape] and moist heat therapy for 30 minutes. Group B, twenty-eight [28] patients underwent passive hamstring stretching, moist heat therapy, and K- tape was applied. Outcome measures selected in this study were pain and range of motion; the pain was measured using a visual analog scale [VAS] and lumbar range of motion using Modified Modified Schober's test. Data were calculated at baseline, midway through the intervention [3rd week], and at the end of the treatment, self-reported pain scale and lumbar range of motion were measured [6th week]. SPSS was used to analyze the data and to draw the statistical and clinical significance of both interventions. The

within-group analysis shows significant differences in the outcome scales; group A was 28.8 ± 1.03, and group B was 17.1 ± 0.97, which offers a considerable difference between the groups. It was also found that group A shows more pain reduction than group B. on comparing the modified modified Schober's sale. Group A was 29.4 ± 1.1, and group B was 7.79 ± 1.3, which shows a significant difference between the groups. It was also found that group A shows more improvement in range of motion than group B. The study concluded that combining the mulligan's TSLR with K-tape effectively reduces pain and improves the range of motion than K-tape with static stretching along.

Keywords: Mulligan's TSLR, K- Tape, Hamstring tightness, Low back pain, Static stretching.

INTRODUCTION

Worldwide, the prevalence of low back pain [LBP] ranges from 50% to 84 percent over a lifetime1. In India, the low back pain occurrence is about 60% at some point in their life span2. LBP is more commonly occurs in younger age groups. It is one of the common causes of long-term disability in young adults [3]. LBP physical findings include pain, limited range of motion, paravertebral muscle spasm, tight hamstring muscles, weak abdominals, tenderness over the lumbar vertebrae, and discomfort if sitting for extended periods [4]. Noted restrictions in the lumbar spine mobility in chronic LBP interfere with the normal activities of daily life and result in pain and long-term disability. Hamstring muscles tightness and low back pain are having a significant relationship with gender and age. Tightness in the hamstring could cause a posterior tilt of the pelvis, which causes back pain5. Less extensibility in the hamstring muscles results in posterior tilting of the pelvis could be a precipitating factor for low back pain. However, according to studies, one of the limitations in the normal lumbar spine and hip movement is increased mechanosensitive of the neural tissues. As such, the restricted activities might have been the result of disease in the somatic or neurological tissues [6].Conservative therapy is applied in the treatment of more than 90% of patients with low back pain. Various non-surgical approaches, such as active physiotherapy, electrotherapy modalities, back school, and exercise, have been prescribed for the treatment of LBP [7]. Different systematic reviews have been conducted to determine which intervention is most effective in reducing absenteeism and disability in LBP [8,9]

Mulligans has developed a new concept that describes the traction straight leg raise technique [TSLR], which improves range of motion and reduces pain10. TLSR techniques are painless interventions that are most beneficial in low back pain with the tightness of hamstrings [11]. This technique restores the normal mobility in the hip and the lumbar spine. Kinesio tape [K-tape] is one of the standard techniques that has been used in the management of low back pain. It was stated that it normalizes the postural muscles, reduces pain, and corrects the joint position [12]. Studies reported that the clinical value of taping applications was small, but they may reduce pain and disability[13,14]. Taping for a wide range of conditions, many studies reporting its benefits have used potentially biased research methods, such as uncontrolled case reports. Although there are various advantages to using Mulligan TSLR on hamstring tightness in low back pain, there is a shortage of research and journal articles. There has been little research into the combined effect of K tape and mulligans TSLR on the lumbar spine. In individuals with mechanical low back pain, it was hypothesized that using the mulligans TSLR in conjunction with K tape would improve the lumbar spine's pain and range of motion compared to K tape alone.

METHODOLOGY

This study is an experimental study conducted in AVMC & H, Pondicherry. One hundred twenty patients who visited the physiotherapy department in the past three months with low back pain are evaluated for the study based on inclusion criteria. Seventy-five patients who are suitable for the study are included. A blinded evaluator did an assessment and selected 56 participants for the study. The inclusion criteria were patients with both gender, age

range of 30—50 years with minimum 4 weeks history of mechanical low backpain, back pain < 5 on 10-cm VAS scale, positive 90-90 test for hamstring tightness, while the radiating pain to the leg or calf, recent injuries to the lower limbs, back pain following trauma, spondylolisthesis, weakness in the lower limbs, and pregnant women are excluded from the study. All the patients were randomly allocated into two groups by the computer-generated randomized table of numbers created before the data collection. Group A, twenty-eight [28] patients who underwent Mulligan's Traction straight leg raise [TSLR] with Kinesiotaping [K-tape]and moist heat therapy for 30 minutes. Group B, twenty-eight [28] patients underwent passive hamstring stretching, moist heat therapy, and K- tape was applied. The home exercise program is given to both groups in printed form. Both groups received treatment for six weeks, with three sessions per week and one session per day. Eighteen sessions were conducted for the patients. Group A, participants underwent Mulligan's TSLR technique described by[14], which involves applying sustained traction to the limbs with the knee extended. Position the patient in supine lying and asked to raise the leg straight without bending the knee.

The straight leg raise was performed, and the range of motion is measured. This technique involved applying sustained maximum traction force to the limb while keeping the knee extended and in line with the long axis of the leg. The limb was moved passively through the range of SLR until discomfort was felt, then immediately returned to the resting position. No pain was ever inflicted. Group B patients underwent standardized K-tape application in the high sitting position [12,15]. Four strips were taken in the shape of "I," one vertical, one horizontal, and two at 45° angles to the vertical strip, were overlapping in a star shape over the point of maximum pain in the lumbar area with 15–25 percent tension. The central part of the strips was pressed and adhered to the tape before the ends, and all stripes crossed at the tape's central point. Till the next visit, the tape should be attached in the place and advised not to remove. At baseline, midway through the intervention [3rd week], and at the end of the treatment, self-reported pain scale and lumbar range of motion were measured [6th week]. The pain was measured using a visual analogue scale [VAS] and lumbar range of motion using Modified Modified Schober's test [16]. (Measurement of the lumbar range of motion using inch tape). SPSS was used to analyze the data and to draw the statistical and clinical significance of both interventions. The sample size of 56 was estimated from Cohen's table using α= 0.05, power =80%, and effect size =0.8. However, 66 participants were recruited in an account of attrition and assigned randomly into two groups. Ten participants didn't complete the six weeks of treatment and did not include their data in the final analysis. In comparison, 56 participants have completed the whole program, and thus this study gives an overall attrition rate of 10%.

RESULTS

Results were analyzed using a parametric test by SPSS version 20.0. Within-group analysis and between-group analysis of pain and range of motion were done and showed a significant difference following the interventions. Clinically, the patients in Group A, who were treated with Mulligan's TSLR with K tape, demonstrated a significant decrease in pain values from 6.46 0.69 to 0.86 0.59 when compared to the patients in Group B. The latter were treated with Static stretching and K-tape, where the pain values decreased from 6.11 0.69 to 2.96 0.69. At the same time, statistically, both the interventions were equally effective in both the groups for pain which was evaluated with a visual analog scale, shown in Table 1. The within-group analysis on the range of motion analysis from Group A, which improves the range of motion from 2.25 ± 0.97 to 8.36 ± 0.49 and Group B, which enhances the range from 2.25 ± 1.04 to 4.14 ± 0.71, while statistically, both the interventions were equally effective in both the groups for pain which was evaluated with modified modified Schober's test, shown in Table 2. The between-group analysis on the pain and the range of motion analysis from Group A & Group B are shown in table 3. On examination, it was statistically demonstrated that the pain values and the range of motion of the lumbar spine were improved significantly in Group A compared with Group B. This shows that the mulligan's TSLR with K- tape produces a significant improvement than the static stretching and K- tape.

DISCUSSION

The study's purpose is to identify the effect of mulligans TSLR in conjunction with K tape on pain and range of motion of the lumbar spine in mechanical low back pain. This study results suggest a substantial improvement in the mulligan TSLR with K tape compared with the K tape only. Despite this, the within-group descriptive analysis showed relatively significant variations in all outcome measures in both groups before and after treatments. When comparing the current findings to previous research on the effect of the Mulligans TSLR approach, the majority of the studies focused on pain, pelvic rotation, active knee extension, and disability, with no studies focusing on lumbar spine range of motion. The study identifies a significant improvement in the application of the mulligans TSLR along with K tapes; it has been noted that the neural tissue mobility is much active in the mulligans TSLR than the hamstring static stretching in the management of the hamstring tightness with LBP. Studies also supported the fact that mulligan's TSLR is effective [17,18]. The proposed mechanism for improving the lumbar spine range of motion may be due to several receptors having an inhibitory effect on lower-alpha motor neuron activity. When using Traction with SLR, the Golgi tendon organs [GTO] around the lower limbs stimulate the segmental reflex pathways[19]; this GTO is engaged during significant amplitude stretching motions like SLR. TSLR has a direct effect on the hamstring muscles, which helps to decrease hamstring tightness. TSLR also reduces motor neuron excitability via I-b fibers and dampens the type II muscle spindle [14]

A single treatment session is practical following immediate effect with the TSLR, and it was found in some studies that there is about an increase of 10ºof range of motion [20]. Pain reduction occurs due to the theory of extinction and habituation. Pain may be considered as a form of aversive memory that, once present, could be more and more easily recalled [21]. Pain reduction is also due to neurophysiological mechanisms that include pain modulation at the spinal and peripheral levels [22]. K-tape widens the interstitial space of the dermis and hypodermis, reducing the pressure in the location[23]. The region's blood flow and mobility increase, resulting in less inflammation and minor irritation of the chemical receptors [24]. Hypothetically, pain reduction occurs due to stimulation of the mechanoreceptor caused by tape application and closing the pain gate [25]. In addition, studies have shown that using K-tape lowers pain and improves function in those suffering from low back discomfort [26]. Because of the reduction in distress, the range of motion improves, as does muscular flexibility [27]. K tape regulates and alters muscular tension while encouraging reactions from the feedback regarding the antagonist's muscle to generate controlled coordinated motion [28]. It is believed that competent K tape treatment can instantly affect muscle balance and contraction [29]. There are numerous possible limitations in this study; potential bias may arise during patient selection and first examination. The technique used on the control group patients may have had a favorable impact on the patient outcomes. The method is compatible with the widely recommended classification of therapy for LBP patients and the incorporation of clinical rationale in the mulligans TSLR studies. Thus, the study concluded that the combination of the mulligan's TSLR with K-tape is much more effective in reducing pain and improving range of motion than K-tape with static stretching along.

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CONFLICT OF INTEREST

Nil declared by the Authors

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Table 1: Pain Scale analysis within groups

Study Groups	Pre test Mean [SD]	Post test Mean [SD]	Mean difference	t value	p value
Group A	6.46 ± 0.69	0.86 ± 0.59	5.61	28.8 ± 1.03	0.0001
Group B	6.11 ± 0.69	2.96 ± 0.69	3.15	17.1 ± 0.97	0.0001

Table 2: Lumbar range of motion analysis within groups

Study Groups	Pre test Mean [SD]	Post test Mean [SD]	Mean difference	t value	p value
Group A	2.25 ± 0.97	8.36 ± 0.49	6.11	29.4 ± 1.1	0.0001
Group B	2.25 ± 1.04	4.14 ± 0.71	1.89	7.79 ± 1.3	0.0001

Table 3: Between group Analysis for the Pain and Range of motion

Study Groups	Group A Mean [SD]	Group B Mean [SD]	Mean difference	t value	p value
VAS	0.86 ± 0.59	2.96 ± 0.69	2.1	12.2 ± 0.64	0.0001
MMST	8.36 ± 0.49	4.14 ± 0.71	4.22	26 ± 0.61	0.0001

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RESEARCH ARTICLE

Ramanujan Summation for Arithmetico – Geometric Progressions

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ABSTRACT

Ever since the concept of Ramanujan summation was introduced by Srinivasa Ramanujan, it has been study of intense research and paved way for entertaining new results in summability theory. In this paper, I had introduced Arithmetico – Geometric Progression and had determined Ramanujan summation for such progressions. A general theorem followed by a corollary containing three new results has been derived in this paper. These results will provide more understanding regarding methods of Ramanujan summation. Suitable figures were provided to gain geometrical interpretation of the results obtained.

Keywords: Arithmetico – Geometric Progression, Common Difference, Common Ratio, Ramanujan Summation, Divergent Series

INTRODUCTION

Assigning a particular value through some mathematical way for a divergent series was the main idea behind Cesaro summation. The prominent Indian mathematician Srinivasa Ramanujan introduced a novel method of summing several divergent series similar to Cesaro summation and obtained curious answers, which others could not understand at the first sight. Once the concept behind Ramanujan summation was revealed, several mathematicians tried to generalize the ideas presented by Ramanujan to include various possibilities. In this paper, I have made one such attempt in determining Ramanujan summation for Arithmetico – Geometric progressions.

Definitions

Let *a*, *d*, *r* be three real numbers such that $d \neq 0$ and $r > 1$. Then the sequence whose terms are given by $a,(a+d)r,(a+2d)r^2,(a+3d)r^3,\ldots \quad (2.1)$ is called Arithmetico – Geometric Progression abbreviated as AGP. The numbers *d* and *r* are called common difference and common ratio of the AGP respectively.

2.2 Let $\sum_{n=0}^{\infty} a_n$ be a divergent sequence of real numbers. Then the Ramanujan summation abbreviated as *RS* of $\sum_{n=0}^{\infty} a_n$ is defined (see **[1]**) by $(RS)\left(\sum_{n=0}^{\infty} a_n\right) = \int_{n=-1}^{0} \left(\sum_{k=0}^{n-1} a_k\right) dn$ (2.2)

Sum of first *n* terms of Arithmetico – Geometric Progression

Let S_n denote the sum of first *n* terms of AGP defined in (2.1).

$$S_n = \sum_{k=0}^{n-1} (a+kd) r^k = a\sum_{k=0}^{n-1} r^k + d\sum_{k=0}^{n-1} k\, r^k$$

$$= \frac{a\left(r^n - 1\right)}{r-1} + dr\left(1 + 2r + 3r^2 + \cdots + (n-1)r^{n-2}\right)$$

Now we will compute $1 + 2r + 3r^2 + \cdots + (n-1)r^{n-2}$ as follows

$$1 + 2r + 3r^2 + \cdots + (n-1)r^{n-2} = \frac{d}{dr}\left(r + r^2 + r^3 + \cdots + r^{n-1}\right)$$

$$= \frac{d}{dr}\left(\frac{r^n - r}{r-1}\right) = \frac{r^n(n-1) - nr^{n-1} + 1}{(r-1)^2}$$

Hence the sum of first *n* terms of AGP is given by

$$S_n = \frac{a\left(r^n - 1\right)}{r-1} + dr\left[\frac{r^n(n-1) - nr^{n-1} + 1}{(r-1)^2}\right] \quad (3.1)$$

Ramanujan Summation of AGP

Theorem 1

$$(RS)\left(a + (a+d)r + (a+2d)r^2 + (a+3d)r^3 + \cdots\right) = \frac{a-d}{r\log_e r} + \frac{a-(a-d)r}{(r-1)^2} - \frac{d}{r(\log_e r)^2} \quad (4.1)$$

Proof: Using (2.2) and (3.1), we have

$$(RS)\left(\sum_{k=0}^{\infty} (a+kd) r^k\right) = (RS)\left(a + (a+d)r + (a+2d)r^2 + (a+3d)r^3 + \cdots\right)$$

$$= \int_{n=-1}^{0} \left(\sum_{k=0}^{n-1} (a+kd) r^k\right) dn = \int_{n=-1}^{0} \left[\frac{a\left(r^n - 1\right)}{r-1} + dr\left[\frac{r^n(n-1) - nr^{n-1} + 1}{(r-1)^2}\right]\right] dn$$

$$= \frac{a}{r-1}\int_{n=-1}^{0} r^n\, dn - \frac{a}{r-1}\int_{n=-1}^{0} dn + \frac{dr}{(r-1)^2}\int_{n=-1}^{0} (n-1)r^n\, dn$$

$$- \frac{dr}{(r-1)^2}\int_{n=-1}^{0} nr^{n-1}\, dn + \frac{dr}{(r-1)^2}\int_{n=-1}^{0} dn$$

Evaluating the integrals we get

$$\int_{n=-1}^{0} r^n\, dn = \left(\frac{r^n}{\log_e r}\right)_{n=-1}^{0} = \frac{r-1}{r\log_e r}, \quad \int_{n=-1}^{0} dn = 1$$

$$\int_{n=-1}^{0} (n-1)r^n\, dn = \left[(n-1)\left(\frac{r^n}{\log_e r}\right) - \left(\frac{r^n}{(\log_e r)^2}\right)\right]_{n=-1}^{0} = \frac{2-r}{r\log_e r} - \frac{r-1}{r(\log_e r)^2}$$

$$\int_{n=-1}^{0} nr^{n-1}\,dn = \frac{1}{r}\int_{n=-1}^{0} nr^{n}\,dn = \frac{1}{r}\left[\int_{n=-1}^{0}(n-1)r^{n}\,dn + \int_{n=-1}^{0} r^{n}\,dn\right]$$

$$= \frac{1}{r}\left[\frac{2-r}{r\log_e r} - \frac{r-1}{r(\log_e r)^2} + \frac{r-1}{r\log_e r}\right] = \frac{1}{r}\left[\frac{1}{r\log_e r} - \frac{r-1}{r(\log_e r)^2}\right]$$

Substituting these integral values, the desired sum is given by

$$(RS)\left(\sum_{k=0}^{\infty}(a+kd)r^k\right) = (RS)\left(a+(a+d)r+(a+2d)r^2+(a+3d)r^3+\cdots\right)$$

$$= \frac{a}{r\log_e r} - \frac{a}{r-1} + \frac{dr}{(r-1)^2}\left[\frac{2-r}{r\log_e r} - \frac{r-1}{r(\log_e r)^2} - \frac{1}{r^2\log_e r} + \frac{r-1}{r^2(\log_e r)^2} + 1\right]$$

$$= \frac{a}{r\log_e r} - \frac{a}{r-1} + \frac{dr}{(r-1)^2}\left[-\frac{(r-1)^2}{r^2\log_e r} - \frac{(r-1)^2}{r^2(\log_e r)^2} + 1\right]$$

$$= \frac{a}{r\log_e r} - \frac{a}{r-1} + \frac{dr}{(r-1)^2} - \frac{d}{r\log_e r}\left(1+\frac{1}{\log_e r}\right)$$

$$= \frac{a-d}{r\log_e r} + \frac{a-(a-d)r}{(r-1)^2} - \frac{d}{r(\log_e r)^2}$$

This proves (4.1) and completes the proof.

Corollary

If $r > 1$ is any real number, then

$$(RS)\left(1+2r+3r^2+4r^3+\cdots\right) = \frac{1}{(r-1)^2} - \frac{1}{r(\log_e r)^2} \quad (4.2)$$

$$(RS)\left(1+3r+5r^2+7r^3+\cdots\right) = \frac{-1}{r\log_e r} + \frac{1+r}{(r-1)^2} - \frac{2}{r(\log_e r)^2} \quad (4.3)$$

$$(RS)\left(r+2r^2+3r^3+4r^4+\cdots\right) = \frac{-1}{r\log_e r} + \frac{r}{(r-1)^2} - \frac{1}{r(\log_e r)^2} \quad (4.4)$$

Proof: If we choose $a = 1$, $d = 1$ in (4.1), we get (4.2). Similarly, by choosing $a = 1$, $d = 2$ in (4.1), we get (4.3) and for the choice of $a = 0$, $d = 1$ in (4.1), we get (4.4).

Geometric Illustrations

I have represented Figures 1, 2 and 3 in this section as verification of results obtained in equations (4.2), (4.3) and (4.4), by considering $r = 2$ in each case.

In view of (2.2), Ramanujan summation is viewed as signed area of the considered series as function of its first n terms with respect in the interval $[-1, 0]$. By (3.1), we see that the graph of the function representing sum of first n terms corresponding to the series $1+4+12+32+\cdots$ lies below X – axis with respect to $[-1, 0]$. Hence the Ramanujan summation of $1+4+12+32+\cdots$ is a negative value given by -0.0406844905028 approximately.

The graph of the function representing sum of first *n* terms corresponding to the series $1+6+20+56+\cdots$ lies above X – axis with respect to $[-1,0]$. Hence the Ramanujan summation of $1+6+20+56+\cdots$ is a positive value given by 0.19728349855 approximately.

Similarly, the graph of the function representing sum of first *n* terms corresponding to the series $2+8+24+64+\cdots$ lies above X – axis with respect to $[-1,0]$. Hence the Ramanujan summation of $2+8+24+64+\cdots$ is a positive value given by 0.237967989053 approximately.

CONCLUSION

In this paper, after deriving sum up to first *n* terms of Arithmetico – Geometric Progression (AGP) in equation (3.1), I had determined the Ramanujan summation which is viewed as signed area of the sum obtained in (3.1) in the interval $[-1,0]$. Equation (4.1) provides the desired Ramanujan summation of general AGP. This result is viewed as a general case of what Ramanujan proved in his famous notebooks. Thus, the result (4.1) of theorem 1 is a generalized version of the usual Ramanujan summation formula. Three special cases of the more general result obtained in (4.1) were presented in equations (4.2), (4.3) and (4.4). The consideration that $r > 1$ ensures that the answers obtained are well defined and the corresponding series are divergent. In section 5, by considering $r = 2$, I had obtained Ramanujan summation for three series and the geometrical meaning behind the answers were explained through the graphs displayed in Figures 1, 2 and 3. These graphs provide the verification of the answers derived in corollary through equations (4.2), (4.3) and (4.4). Further, by considering different values of *r* greater than 1, we can immediately determine the Ramanujan summation of the corresponding divergent series through (4.2), (4.3) and (4.4). Thus the results derived in this paper helps us to determine Ramanujan summation of variety of different divergent series of real numbers. These ideas will add more understanding to the huge literature of Ramanujan summation methods which has connection with Riemann zeta function.

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Figure 1: $(RS)(1+4+12+32+\cdots)=1-\dfrac{1}{2(\log_e 2)^2}=-0.0406844905028$

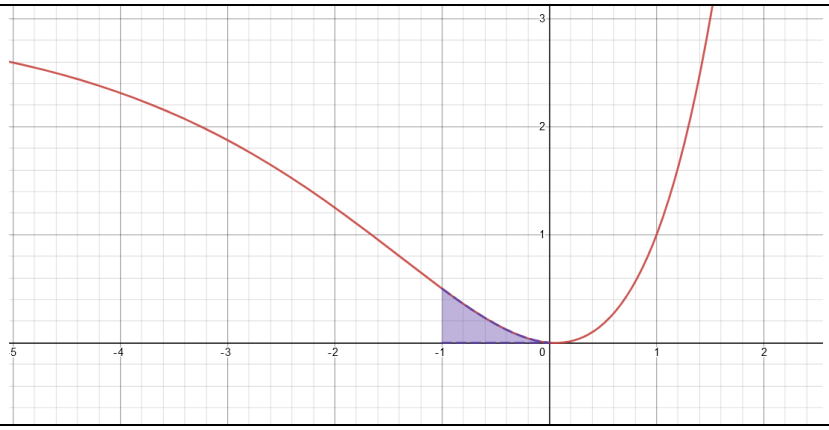

Figure 2: $(RS)(1+6+20+56+\cdots)=-\dfrac{1}{2\log_e 2}+3-\dfrac{1}{(\log_e 2)^2}=0.19728349855$

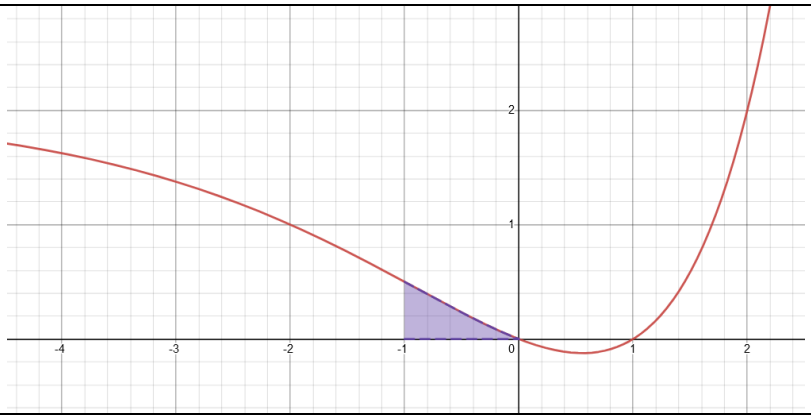

Figure 3: $(RS)(2+8+24+64+\cdots)=-\dfrac{1}{2\log_e 2}+2-\dfrac{1}{2(\log_e 2)^2}=0.237967989053$

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RESEARCH ARTICLE

Effect of Myofascial Release Therapy on Post Exercise Recovery in Athletes

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ABSTRACT

Recovery from rest is the essential component of physical fitness. Usually, an excellent nutritious drink and rest will restore recovery. Some of the physical modalities like cryotherapy, stimulation, and massage are mostly recommended. Since there was no study on the role of myofascial release therapy on post-exercise recovery, this study aimed to find out the effect of myofascial release therapy on post-exercise recovery in young athletes. This study is a single group study with twenty-five young athletes selected from volunteers. Following a thorough explanation of the study, all participants were given a protocol that included a five-time vertical jump to familiarize them with the techniques. The participants were told to perform three maximal vertical jumps for three repetitions during the testing period, followed by a 30-second pause before performing another three jumps. The measurements were performed at four different periods: baseline, 0 hours, 24 hours, and 48 hours. After 30 seconds of the jumping, they all received myofascial release therapy (MFR) to the lower limbs for 10 minutes. Approximately 30 seconds after receiving the MFR, the fatigue resisting scale was calculated (0 hours), and the follow-up measurement was taken exactly 24 hours and 48 hours after the jumping exercises. The result of the study was identified using SPSS 20.0, and it was found that the probability of this result, assuming the null hypothesis, is less than .0001. This study concluded that myofascial release therapy would play a significant role in post-exercise recovery and helps the participants to recover faster.

Keywords: Myofascial release therapy, Post exercises recovery, Fatigue resisting scale, Vertical jump.

INTRODUCTION

The time between the end of a training session and the subsequent return to the recovery state is referred to as post-exercise recovery. It is a physiological process in which the muscles return to their normal state after vigorous training [1]. Recovery after exercise training is an essential component of the overall training for optimal performance and improvement [2]. Recovery from training is becoming recognized as one of the critical aspects of physical activity and overall wellness. The removal of metabolites and end products such as lactic acid and hydrogen ions characterizes muscle recovery. Muscle recovery is necessary to re-establish blood flow in the muscles, which improves oxygen delivery and promotes the replenishment of phosphocreatine stores, restoring acid-base balance (intramuscular pH) and re-establishing the re-establishment of muscle membrane potential [3]. Within a few hours of exercising, muscle tissue goes through a damage-regeneration cycle. Exercise causes the regeneration of new muscle fibers by containing mitochondria, increasing blood flow, and increasing metabolic activities. Recovery is critical for muscle regeneration [4].

Intense exercise causes muscle soreness, a rise in core temperature, muscle glycogen depletion, dehydration, and soft tissue damage. It even causes harm to the nervous system, cardiovascular system, renal system, and endocrine system[5]. The process whereby the body restores homeostasis is known as recovery [6]. Rest, repair body tissues, restore homeostasis, and replace fuels and fluids are the general goals of post-exercise recovery. Rest, nutritional drinks, and physical interventions are the most frequently used treatments [7]. Passive stretching, massage, and hydrotherapy are some of the older physical interventions developed and used for a long time, as are some of the newer interventions such as NMES, vibration therapy, cryotherapy, and compression garments. Regardless of the fact that various physical interventions are used, their benefits are less well established [8].There is a need for well-designed recovery schedules, which are crucial for reduces the level of overreaching and optimizing the ability to adapt.

Myofascial release therapy (MFR) is a type of soft tissue massage that promotes myofascial mobility and alleviates pain in the muscular system. Myofascia is a type of connective tissue that lies beneath the skin and surrounds the bones, muscles, tendons, and ligaments [9]. It has been hypothesized that fascia can cause abnormal crosslinks and changes in the viscosity of the ground substance, making fascia less pliable, restricting movement patterns, and predisposing to injury[10]. MFR is a slow, effective technique for detecting fascial tightness and relieving facial restriction [11]. There is little scientific evidence to support MFR for post-exercise recovery, and the literature also promotes self-myofascial release or myofascial foam rolling. There is still no definitive study that examines the impact of MFR. As a result, the study's primary objective was to see whether the MFR had any effect on post-exercise recovery with time intervals.

METHODOLOGY

A single group study with twenty-five young athletes were selected. This study was approved by the Institutional ethical committee AVMC & Hospital, Puducherry, India. This study was conducted in the Department of Physiotherapy, AVMC & Hospital. The sample size was estimated according to the power analysis of 80%. Twenty-five healthy male participants with the mean age of 21.52 years (S.D 2.47), who do moderate endurance activity in regular were involved in the study. All the volunteer participants were included in the study were screened based on the predetermined study criteria. Participants with an age group of 18—25 years, collegiate students, participants who do moderate physical activity (minimum 2.5 hours of endurance exercises), participants without any recent musculoskeletal injury, neurological injuries, no current pain, and no cardiovascular problems. Initially, the baseline measurements were taken after the participants with prior appointments. All the participants were instructed to do the vertical jump five times. This was conducted to make them familiarize themselves with the testing protocol. Participant's fatigue resisting scale [12] was measured prior to the jumping exercise protocol. All the participants

were advised to perform three maximal vertical jumps for three repetitions and 30 seconds pause, and then three jumps were performed [13]. The maximal jumping reach was measured using a ruler and inch tape. The assessment was taken as baseline, 0 hours, 24 hours, and 48 hours. After 30 seconds of the jumping, they are all received myofascial release therapy (MFR) to the lower limbs for 10 mins. Approximately after 30 seconds after receiving the MFR, the fatigue resisting scale was calculated (0 hours), and the follow-up measurement was taken exactly 24 hours and 48 hours after the jumping exercises.

Testing Protocol: Participants didn't perform any warming up exercises or stretching exercises before the jumping exercises. All the participants were instructed to perform maximal jumping performance in the vertical jump at least 30 jumps. All the jumps start from the crouching position to the maximal raise and come back to the crouching position [14]. Two research assistants were inspecting the quality of the jumps and do correct the technique if needed. Between the exercise's participants were given 30 seconds of pause and allowed to sit down. This ensured an accumulative overload of all participants [14].

MFR Protocol: MFR was applied for the lower limbs as soon as the evaluation is done, participants were made in lying position and gross stretch of quadratus lumborum, the cross-hand stretch of quadriceps, Gross stretch of Sartorius, Gross stretch of tensor fascia, and Gross stretch of tibialis anterior [15].

RESULT

The data were analyzed using the SPSS 20.0 statistical package. This study used ANOVA because it looked at different periods like baseline, 0, 24, and 48 hours. The data collector noted the variations in the values. The significance level does set at P0.05. Table I detailed the demographic variables for all the participants. A correlation was conducted between the fatigue rating scale and age range, and it has found no relationship between the two variables (-0.89). On analyzing the relationship between the fatigue scale and the participant's weight and height, the participants also showed no relationship, which was -0.91 and -0.78, respectively. Comparing the fatigue rating scale with the duration of exercises previously done by the participants shows no relationship (-0.90). Comparing the fatigue rating scale with years of exercise by the participants shows a mild relationship (0.89). The correlations are not providing appropriate information to the study. The inference of the ANOVA analysis shows that there was a significant difference between the fatigue rating scale upon analysis at different times. So, it has been shown that myofascial release therapy would be beneficial in promoting muscle recovery.

DISCUSSION

The purpose of the study was to find out the effect of myofascial release therapy on post-exercise recovery in young athletes. Intensive exercises always result in fatigue, which results in a reduction in performance. Therefore, adequate recovery between the sessions is essential to minimize the risk of muscle soreness and generalized body fatigue. Excessive training leads to stress of the tissues, resulting in temporary impairment of the performance capacity with psychological or physiological maladaptation. To restore the performance capacity requires several days to weeks [8]. Literature suggested that active recovery always leads to better exercise performance in subsequent bouts of exercise performed during the single experimental session [16]. Myofascial release therapy is a soft tissue technique that is widely used to treat pain and soreness. It aids in the breakdown of adhesions in the fascia, muscles, and ligaments. Myofascial release therapy is one of the soft tissue techniques commonly recommended for pain and soreness. It helps to break down the adhesions in the fascial structures, muscles, and ligaments. It relaxes the fascia and makes the facia more pliable and softer [11,15]. MFR is essential to prevent further injuries, and it enhances the performance of athletes.

Mauntel et al., 2014, reviewed a systematic review on the effectiveness of various myofascial therapies, including such positional release therapy, trigger point mobilization, active release technique, and self-myofascial release on

muscle force, range of motion, and muscle activation and stated that MFR helps to improve post-exercise recovery considerably [17]. A study done by Schroeder et al. 2015, concluded that self-myofascial release therapy is beneficial in pre-exercise and healing. The application of MFR alters joint range due to alteration of the viscoelastic and thixotropic property of the fascia and increases intramuscular temperate and blood flow [18]. It also alters the muscle spindle length or stretch perception and mechanically breaking down the scar tissue and remobilizing the facia back to a normal state [10]. This study also identifies that MFR produces significant changes in the vertical jump before and after interventions. The participants were improved well after 48 hours of the measurement. There was a vital statistical significance also obtained between the duration of measurements.

CONCLUSION

In conclusion, the current study confirms that MFR plays a significant role in post-exercise recovery in young athletes. It had hypothesized that a longitudinal study with different research protocols could be more successful in providing valuable information for future researchers. Further study is needed to include the timings like morning, afternoon, and evening to identify the effect of interventions. Further, it also needs to study on post exercises recovery, which maintains longitudinal ecological settings.

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CONFLICT OF INTEREST

The authors have none to declare.

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Table 1: (Demographical analysis)

Variables	Mean	S.D
Age	21.52	2.47
Height	168.6	5.35
Weight	68.28	6.41
Duration of exercises		
< 30 mins	21.77	2.77
30-1 hr	20.42	1.72
> 1 hr	21.6	2.7
Years of exercises		
0-3 years	21.18	2.76
3-6 years	21.84	1.83
> 6 years	24.68	0.577

Table 2: Shows the ANOVA Analysis

Source of Variations	Sum of Squares	d.f	Mean Squares	F
Between	406.1	3	135.4	435.5
Error	29.84	96	0.311	
Total	436	99		

* The probability of this result, assuming the null hypothesis, is less than .0001

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RESEARCH ARTICLE

Immunomodulatory Effects of *Tinospora cordifolia* (Guduchi) - An Update in COVID-19 Pandemic Times

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ABSTRACT

Medicinal plants have been part of traditional health care in most part of the world for thousands of years. One such plant that has gained importance in the recent times, especially in COVID-19 pandemic times is the Guduchi plant, scientifically called as *Tinospora cordifolia* that belongs to the family Menispermaceae. It is an important plant in Ayurvedic system of medicine. It has many other names; commonly known as Giloe/Giloy in Hindi, Samavalli in Sanskrit, Gulavel in Marathi, Gulancha in Bengal, Seendal in Tamil, to name a few. Guduchi plant parts – leaves, stem and root extracts are rich in phytochemicals such as tannins, steroids, saponins, alkaloids, flavonoids, cardiac glycosides and phenolic compounds that are associated with numerous medicinal properties such as anti-inflammatory, antidiabetic, anti-arthritic, antioxidant, antistress, anti-malarial, anti-allergic, immunomodulator and immune stimulator. In Ayurveda, Guduchi is part of "Medhya Rasayana" which is a cognition and rejuvenation enhancer associated with mental wellbeing. This review updates the immunomodulatory effects of *Tinospora cordifolia* (Guduchi) in viral infection, macrophage activation, Human acquired immuno deficiency disease (HIV-AIDS) and COVID-19 disease.

Keywords: Guduchi, *Tinospora cordifolia,* COVID-19, Giloy, Immunomodulator, HIV-AIDS

INTRODUCTION

Medicinal plants have been part of traditional health care in most part of the world for thousands of years. In developing countries, majority of population are dependent on plants for their medicinal values apart from food. India, owing to its ideal tropical climatic conditions, is one of the richest countries in the world with huge diversity of medicinal plants. Over the past few years, there has been increased awareness about importance and uses of

medicinal plants. One such plant that has gained importance in the recent times, especially in COVID-19 pandemic times is the Guduchi plant, scientifically called as *Tinospora cordifolia* (Wild) Hook. f. & Thomson. *Tinospora cordifolia* (synonym: *Tinospora sinensis* (Lour.) Merr.) is a climbing shrub that belongs to the family Menispermaceae. It consists of about 70 genus and 450 species that are found in low tropical region. Guduchi is commonly known as Giloe/Giloy in Hindi, Samavalli in Sanskrit, Gulavel in Marathi, Gulancha in Bengal, Seendal in Tamil, to name a few. Leaves, stem and root of this plant are used as medicine [1]. Guduchi plant has various phytochemical secondary metabolites such as tannins, steroids, saponins, alkaloids, flavonoids, cardiac glycosides and phenolic compounds [2]. It has numerous medicinal properties such as anti-inflammatory, antidiabetic, anti-arthritic, antioxidant, antistress, anti-malarial, anti-allergic and immunomodulatory activities [3]. Guduchi is used as an important ayurvedic medicine in treatment of fever, liver and spleen disorders, bleeding diseases, burning sensation due of heat, etc. [4]. It is also used in treating children suffering from upper respiratory tract infection [5].In Ayurveda, Guduchi is part of "Medhya Rasayana" which is a cognition and rejuvenation enhancer associated with mental wellbeing because of its proven IQ level booster [6]. It has both internal and external therapeutic usage under various formulations [7]. It is wellknown for its immune modulator properties [3,8]. Numerous formulations using Guduchi plant extracts were tested in recent times to enhance its immunomodulatory effects. This review updates the immunomodulatory effects of this plant extracts through some of the recent studies.

PLANT DESCRIPTION

Taxonomic Classification

Taxonomic classification of *Tinospora cordifolia* has been provided in Fig.1.

Tinospora cordifolia is a perennial, succulent, climbing shrub native to lower elevation in tropical areas of the Indian subcontinent and climbs numerous types of trees to great heights and sometimes puts forth long aerial roots. The bark of this shrub is creamy white and greyish in colour and exudes a yellow coloured viscous sap having a bitter odour[9].

Habitat and Distribution

Tinospora cordifolia (Guduchi) grows in a wide range of soil conditions and requires moderate level of soil moisture. It is found in deciduous and dry forests at elevations up to 1000ft. It is indigenous to India, Myanmar, Sri Lanka, China, Thailand, Philippines, Indonesia, Malaysia, Borneo, Vietnam, Bangladesh, North Africa, West Africa and South Africa [10,11].Plant is distributed throughout the tropical region of India upto 1,200 m above sea level. It is commonly cultivated throughout the country. Plant is found in Assam, Gujarat and Uttar Pradesh pan India. It grows almost throughout in India [12].

Major plant parts and their medicinal values

Figure 2 depicts the various parts of *Tinospora cordifolia* (Guduchi) plant.

Table 1 lists the medicinal uses of various parts of *Tinospora cordifolia*plant.

Phytochemical constituents

Phytochemicals are the chemicals produced by plants through primary or secondary metabolism [22]. Phytochemical analysis are used to study the presence of bioactive compounds that may lead to the drug discovery and drug development [23]. It can also assist as a good source for drugs preparation [22,23].*T.cordifolia* has several chemical compounds such as alkaloid, steroid, glycosides, aliphatic compounds, oil, mixture of fatty acid and polysaccharides that serve as significant source for development of novel medicines. They also work as quality control index for a drug [23]. Various parts of the plants such as leaves, stem, root and barks have yielded several pharmacologically important compounds such as alkaloids (berberine, palmatine, tetrahydropalmatine, tembetarine, jatrorrhizine, magnoflorine), diterpenoid lactones (furanolactone, tinosporide, columbin), sesquiterpenoid, steroids (ecdysterone, makisterone A, β-sitosterol), glycosides (cordifolioside A, B, C, D, E, tinocordifolioside, syringin),polysaccharides,

amritosides A, B, C and aliphatic compounds, most of which have been structurally elucidated spectroscopically [24,25,26].The major phytoconstituent specific to *T.cordifolia* include Tinosporine, tinosporide, tinosporaside, cordifolide, cordifol, heptacosanol, clerodanefurano diterpene, diterpenoid furanolactonetinosporidine, columbin and β-sitosterol. Compounds such as berberine, palmatine, tembertarine, magniflorine, choline and tinosporin have been reported from its stem extracts [9,12]. According to recent studies, *T.cordifolia* possesses significant antioxidant activities due to the presence of variety of flavanoid compounds [27].Antioxidant rich leaf and stem extracts of *T. cordifolia* act as a source of nutraceuticals to improve the oxidative stress and helps in prevention and reduction of the degenerative diseases leading to health benefits [25,28,29]. An arabinogalactan (G1-4A), isolated from the dried stem has demonstrated immunomodulatory properties through activation of B cells and macrophages [30,31]. A novel polysaccharide RR1 (1,4 α-D-glucan) isolated from *T. cordifolia* having a molecular weight of over 550kDa, was demonstrated to have immunostimulatory properties through macrophage activation in rat models [32].
Phytochemicals in *Tinospora cordifolia* plant part extracts with their bioactivity observed has been listed in the table (Table 2) below:

Medicinal properties of Guduchi

Guduchi (*T.cordifolia*) is generally called as 'Queenofallherbs'. Guduchi is one of the bestvalued herbs in Ayurvedic collection [27]. It is used for various medicinal purposes [43]. All parts of the plant are useful which has been reported by many ethnobotanists [18]. It is an important drug used in different methods of ayurvedic preparation like satva, ghrita, tel, swaras etc. It is also one of the important components in many formulations used for treating various diseases [44]. Guduchi plant consists of significant medicinal uses that play a main role in strengthening the immune system, skin, liver, spleen, stomach, blood, intestine and also used to treat the chemotherapeutic sideeffects [27]. *T.cordifolia* is currently used in modern medicines to reduce the harmful effects of chemotherapy [45]. Various studies and clinical trialson *T.cordifolia* specify the safety and their role in health supplement on commercial basis andas a depository for drug development in critical diseases in the forthcoming years [46]. Guduchi plant is widely gaining more recognition for its significant medicinal values. Medicinal properties of Guduchi plant are represented in the figure (Fig.3) below [6,15,47].

Green Synthesis of Nanoparticles using Guduchi Extract

In recent times, nanoparticles have gained attention in research and technology. Nanotechnology is the study and application of small objects that can be used in all fields such as chemistry, biology, physics, materials science, and engineering. Green synthesized nanoparticles have potential for large-scale production, because of economical and environmentally friendly synthesis methods. Many studies have focused on this method to synthesize *Tinospora cordifolia* extract based nanoparticles and characterize them and analyze their medicinal properties. Predominantly, silver nanoparticles (AgNPs)biosynthesized using Guduchi leaf and stem extracts have been used to demonstrate strong antibacterial efficacy against gram-positive and gram-negative bacteria such as *Escherichia coli, Pseudomonas syringae, Klebsiella pneumoniae, Staphylococcus aureus, Streptococcus pyogenes, Serratia marcescens, Vibrio cholerae, Micrococcus luteus* and *Enterococcus faecalis* [48,49,50,51]. Biosynthesised AgNPs have also exhibited *in vitro* cytotoxic activity against HepG2 cancer cell line [52] and good antioxidant activity [51]. Raj and Jayalakshmy (2015) have successfully biosynthesised zinc oxide (ZnO) nanoparticles using Guduchi stem extracts and have characterised them using SEM, EDX and FTIR techniques. Biosynthesised ZnO nanoparticles can thus serve as a simple, cost effective and an ecofriendly alternative to conventional chemical method [53]. More recently, Ragavee and Devi (2019) have synthesised polymeric *Tinospora cordifolia*-loaded poly lactic acid nanoparticles from Guduchi stem extracts using solvent evaporation method. TC-loaded PLA NPs have demonstrated antidiabetic activity through *in vitro* α-Glucosidase inhibitory activity. Their study proved that Guduchi stem extract possessed a therapeutic effect on diabetes. This was evident through their *in silico* drug docking study showing the highest binding affinity with insulin receptor which acts as an insulin activator and responsible for the inhibitory action of α-glucosidase. The synthesised polymeric NPs can thus be used as antidiabetic drug delivery molecules due to the properties such as biodegradability, biocompatibility, high stability and encapsulation efficiency, and sustained release effect [54].

Immunomodulatory activity of Guduchi

Immunomodulation refers to alteration in the immune system of an organism by interfering with its function. Modulation of an immune system may result in stimulation or suppression or restoration of immunological activity or helping to evoke a desired immunological response. Medicinal plants and their extracts of active components are becoming increasingly important as a source of immunomodulatory agents. Alcoholic and aqueous extracts of Guduchi plant have shown several immunostimulatory compounds, demonstrating immunomodulatory activities in several *in vitro* and *in vivo* animal studies, till date [9,30,31,32,38]. Specific compounds isolated from *T. cordifolia* such as Magnoflorine, N-methyl-2-pyrrolidone, 11- hydroxyl mustakone and Tinocordiside have shown immunomodulatory effects by enhancing Reactive Oxygen Species (ROS) generation which results in augmentation of immune response [38]. In addition to that, a novel (1,4)- α-D-glucan isolated from *T. Cordifolia* have shown to stimulate the immune system by activating macrophages via of TLR6 signalling and NF-κB activation mechanism, leading to cytokine and chemokine production [32]. Desai et al., (2007) further demonstrated that this novel G1-4A polysaccharide modulates macrophage responses and protects mice against lipopolysaccharide induced endotoxic shock, thus inducing tolerance against endotoxic shock by modulation of cytokines and nitric oxide [31]. This polysaccharide has ability to induce NK cells, B cells, and T cells with simultaneous production of various immune-stimulatory cytokines. It has also demonstrated inhibition of intracellular growth of *Mycobacterium tuberculosis* through toll-like receptor 4- (TLR4-) dependent signalling[55]. A 25 kDa immunomodulatory protein (ImP) was isolated from dry stem powder of *Tinospora cordifolia* by Aranha et al., (2011) and was shown to exhibit significant mitogenic activity towards murine and human lymphocytes. This Guduchi ImP also displayed significant stimulatory effect towards murine macrophages as seen by phagocytosis [9]. Their study results reiterated the immunomodulatory role of various Guduchi based ayurvedic preparations.

T. cordifolia extract (TCE) also exhibits a considerable effect on the immunostimulation in HIV positive patients and increases the phagocytosis and intercellular killing capacity by increasing the survival rate and polymorphonuclear leucocyte function. This was displayed by one of the earliest clinical trials done on HIV patients by Kalikar et al., (2008) using Guduchi extracts. Their study had HIV affected individuals as volunteers divided into TCE group and the placebo group. While the placebo group displayed significant decrease in the total leucocyte count, the TCE group did not show such a decrease, due to the medicinal effect of the guduchi extract. There was also significant reduction in the eosinophil count in these individuals after six months of treatment, which was not observed in the placebo group [56].Further to this, Estari et al., (2012) demonstrated the anti-HIV activity of Guduchi extract under *in vitro* conditions through HIV reverse transcriptase assay. It showed good inhibitory activity, which was similar to reference drug [57]. Immunoprophylactic potential of two known immunomodulatory agents, *Tinospora cordifolia* (aqueous stem extract) and Cytosine-guanosinedeoxynucleotide oligodeoxynucleotides (CpG ODN)- a (Chicken TLR21 Agonist), were tested against the very virulent Infectious Bursal Disease Virus (vvIBDV) in Specific pathogen free (SPF) Chicks by Sachan et al. (2019) . In addition, they also tested the adjuvant and or immune enhancing ability of these agents on the commercially available IBDV vaccine in the SPF chicks. There was significant reduction in mortality rate in vvIBDV infected chicks treated with either, or in combination of the two agents, compared with the birds of control group. An augmentation of vaccine response in terms of an enhanced antibody titre after vaccination, along with either or a combination of the two agents was also noticed. The study findings suggested the use of these supplements along with vaccination to counter the menace of IBDV in the poultry sector [58] Saeed et al (2020) through their detailed review on use of Guduchi as poultry feed supplement have suggested further detailed research on active components, their possible mechanisms of action, and the effective doses to fully understand the benefits of Guduchi as a growth enhancing supplement in poultry feed [59].

Role of Guduchi in COVID-19 disease

COVID-19 is a respiratory disease caused by coronavirus -SARS Cov-2. Coronavirus proteins are responsible for disrupting the immune response pathway and destroying the immune system. Ayurvedic pharmacological system persuades healthy people to use AmritadiKwath as an immunostimulating drug to boost immunity against the deadly COVID-19 disease. Coronavirus is an enveloped virus with a positive polarized single-stranded RNA

genome. The coronavirus genome encodes four of the most important structural proteins, the spike (S) Protein, nucleocapsid (N) protein, membrane (M) protein, and the envelope E protein each of which is required to form a complete viral particle structure. Coronavirus disease (COVID-19) is a highly contagious disease spread by a viral pathogen. Coronavirus proteins reliably disrupt the immune response and destroy the immune system. Without effective inhibition, the patient suffers from progressive immune damage and is manifested with upper respiratory tract infections (URTIs), Lower respiratory tract infections (LRTIs) and severe acute respiratory syndrome (SARS). Currently, there is no approved cure for COVID-19 disease.

Several herbal formulations have been recommended for the management of COVID-19, such as guduchi or Indian giloy (*Tinospora cordifolia*) and ashwagandha; these have shown to be effective in the management COVID19 in India [60]. Giloy/amrita are extensively used in the Indian system of medicine due to their immunomodulatory properties and ability to boost the nonspecific immune system by acting on the macrophages [32,38]. *Tinospora cordifolia* has been reported to have a positive effect on the immune system and is effective as an immunomodulator [61]. *T cordifolia* extract is also effective against the immunodeficiency virus. In this perspective, Mishra (2020) has suggested AmritadiKwath could be an immunostimulating drug for countering COVID-19 disease through his clinical study [62]. A clinical trial was recently conducted using AmritadiKwath on COVID-19 positive and healthy volunteers to check the immunostimulating effect in COVID-19 disease by Mishra (2020). Freshly prepared AmritadiKwath, which has extracts from stem of Guduchi as one of the main components, was tested on 50 healthy volunteers to assess the immunostimulatory effects. Out of the 50 healthy people, 40 were male and 10 were females in the age range of 18 to 70 years. The Kwath was given in dosage of 20-40 ml for 2 weeks and observations were then made. At the end of two weeks, the tested individuals showed better stamina, strength and positive mind emotions. It was also observed that they did not have fever, cough, difficulty in breathing, tiredness, nasal congestion, runny nose, sore throat and severe diseases like Asthma, bronchitis, pneumonia, etc. during the 2-week period of usage of AmirtadiKwath. This study further suggests that this AmritadiKwath should be further taken up for clinical trials on animal models and affected individuals in various phases to be used as an effective drug against COVID-19 disease [62]. *Tinospora cordifolia* extracts, through many of these studies point out to stimulation of the granulocytes and macrophages formation indicating the presence of granulocytes macrophage colony stimulating factor (CGM-SF). It also induces the neutrophils and stimulates macrophages resulting in a significant increase in serum fibrogen, indicating the possibility of increased IL-1 production. The immunomodulatory activity may be mediated through the spontaneous mitogen activity on splenocytes which potentiates non-specifically the responsiveness of splenocytes to mitogen. This may be indicative of stimulation of both B and T lymphocytes [63].

FUTURE PERSPECTIVE

Guduchi is an important traditional ayurvedic medicine. Research have been carried out in various diseases such as viral infections, HIV-AIDS and more recently in COVID-19 on healthy volunteers. Its immunomodulatory effect has been well established through macrophage activation. However, in case of COVID-19, the clinical studies on affected individuals are still in trial phases. More systematic studies are needed on various extracts of Guduchi plant with larger sample sizes and on various diseases to establish the immunostimulatory and immunomodulatory roles of this wonder drug. This will pave way for the use of this plant extracts in modern medication.

CONCLUSION

In recent times, especially during the COVID-19 pandemic times, *Tinospora cordifolia* plant extract has gained importance due to its immune stimulating effects. It is widely used in several ayurvedic supplements such as Guduchi immunity wellness Giloy of Himalaya Drug Company, Guduchi (Giloy) ghanbati of Baidyanath group, Amritarishta of Kottakkal Ayurveda to name a few and have been in great demand as a preventive medication for COVID-19 disease. Several clinical trial studies are now underway to establish its role as an immune stimulator and

immune modulator. Through this review, available studies on the immune modulatory effects of Guduchi plant has been discussed. This review helps to highlight the immune modulatory role of Guduchi plant and also the need for more studies in systematic way to establish this plant extract as a drug of choice for immune stimulation, especially for viral infections such as HIV-AIDS and COVID-19.

CONFLICTS OF INTEREST

The authors declare no conflict of interest

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Table 1: List of medicinal uses of various parts of *Tinospora cordifolia* plant

S.NO	PLANT PARTS	DESCRIPTION	MEDICINAL USES	REFERENCE
1.	Stem	Long, filiform, fleshy and climbing in nature. Aerial roots arise from the branches. Dried stem is cylindrical, slender, slightly twisted in shape.	Combination of root and stem extract with other herbal drugs are prescribed as anti- dote for snake bite and scorpion sting. Juice of the stem with honey is better for treatment of Asthma.	[4,11,13]
2	Root	Long thread like, aerial, arise from branches.	Root of Guduchi has anti-oxidant activity and it reduces tissue cholesterol, phospholipid and free fatty acids. It is used for visceral obstruction and its water extract is used in leprosy.	[11,14,15,16]
3.	Leaves	Membranous, glabrous, 5-10 cm long, cordate; petiole 2.5-7 cm long. Leaves are bitter and have an indistinct odour.	Guduchi leaves are used to cure leucorrhoea. It is also used to cure rheumatic pain. Leaves are extensively used in the treatment of fever, urinary tract disorder, diabetes, anaemia, asthma, cardiac disorder, bacterial infection	[9,17,18]
4.	Fruits	Fruits are fleshy and single seeded which are found as aggregates of one to three. These are drupelets on thick stalk with sub terminal style scars. The shape of the fruit is ovoid with smooth texture, scarletor orange red in colour.	Combination of dried or powdered fruit with honey is used as tonic for the treatment of rheumatism and jaundice.	[18,19,20]
5.	Bark	The bark is gray or creamy-white, deeply cleft spirally and longitudinally with the space between spotted with large rosette-like lenticels	Anti-pyretic, anti-allergic, anti-spasmodic, anti-leprotic	[19, 21]

Table 2: Phytochemicals in *Tinospora cordifolia* plant part extracts with their bioactivity

S.No.	ACTIVE COMPONENT	COMPOUNDS	BIOACTIVITY	REFERENCE
1.	Alkaloids	Tinosporine, Magnoflorine, Berberine, Choline, Jatrorrhizine, 1,2-Substituted pyrrolidine, palmatine, beberine, tembeterine.	Neuroprotective, Antioxidant, Antipsychotic, Antidepressant, Anticancer, Cardioprotective, Hepatoprotective, Antidiabetic	[33,34,35]
9.	Terpenoids	Tinosporide, Furanolactone diterpene, Furanolactone clerodane diterpene, furanoid diterpene, Tinosporaside, ecdysteronemakisterone and several glucosides isolated as poly acetate, phenylpropene disaccharides	Gastroprotective, Cardioprotective, Hepatoprotective, Anticancer	[35,36, 37,38,39]
	Steroids	Giloinsterol, ß-Sitosterol, 20a-Hydroxyecdysone, Makisterone A	Antiarthritic	[33,34,35]
	Glycosides	cordifolioside A, B and C, cordifoliside D and E, Tinocordioside, cordioside, palmatosides C and F, Sesquiterpeneglucosidetino cordifolioside, Sesquiterpenetino cordifolin, Syrigin.	Immunomodulatory, Radioprotective, Cytoprotective	[35, 40,41,42]
	DiterpenoidLactones	furanolactone, tinosporide, columbin	Antimicrobial	[35,40,41,42]
	Others	Giloin, Tinosporanacetate, Tinosporalacetate, Tinosporidine, Heptacosanol, Octacosanol, sinapicacid, Tinosponone, arabinogalactan (G1-4).	Immunomodulatory	[33,34,35,40,41,42]

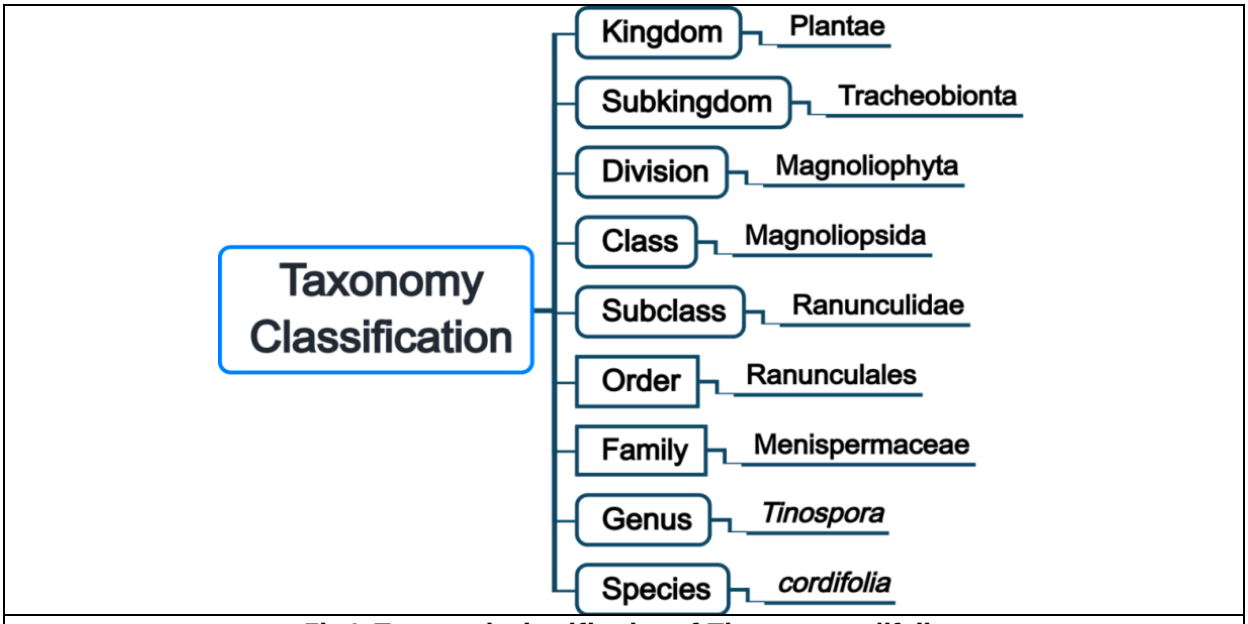

Fig 1: Taxonomic classification of *Tinospora cordifolia*

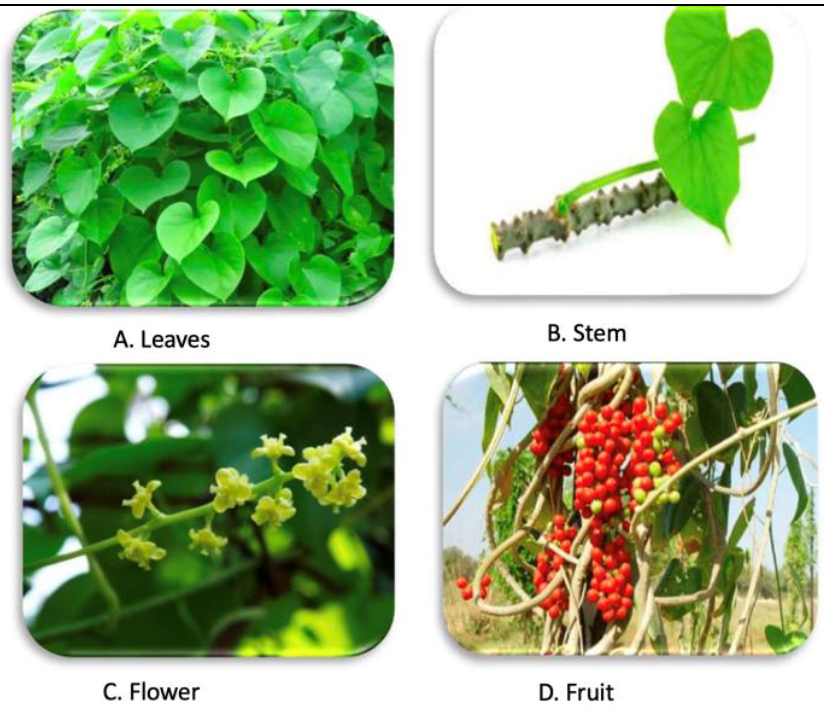

Fig 2: Parts of *Tinospora cordifolia* (Guduchi) plant

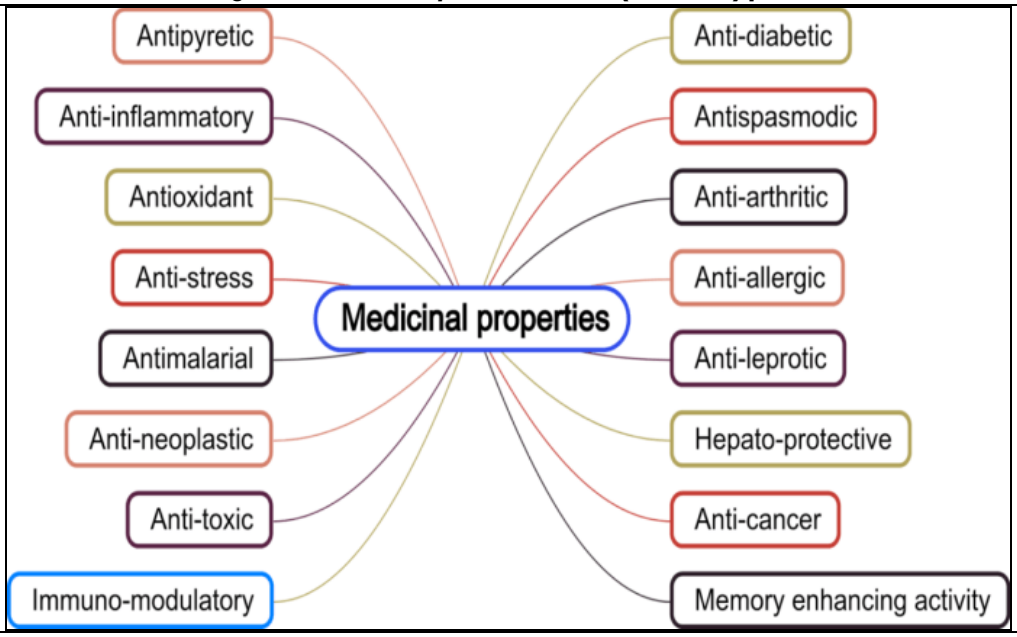

Fig. 3: Medicinal properties of Guduchi plant

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REVIEW ARTICLE

A Review on Category, Benefits and Weakness of Digital Marketing

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ABSTRACT

Digital marketing, in like manner called electronic promoting, is the headway of brands to connect with potential customers using the web and various sorts of automated correspondence. This consolidates not simply email, online media, and electronic publicizing, yet likewise message and sight and sound messages as a displaying channel. Fundamentally, if an advancing exertion incorporates progressed correspondence, it's modernized publicizing. The power of computerized showcasing licenses geophysical limits to disappear making all purchasers and associations on earth anticipated customers and suppliers. It is known for its ability to allow business to bestow and outline a trade wherever and at whatever point. Advanced promoting's are usually diverse, handling for unequivocal electronic publicizing challenges while building advancing client limits. In this paper different classes of cutting-edge promoting methodologies like SEM, SEO, PPC, SMM, Content, Email, Affiliate, Viral, Radio, Television, Mobile advertising and their benefits and deficiency are tended to.

Keywords: Digital marketing, SEO, PPC, SEM, SSM, Content marketing, Mobile marketing

INTRODUCTION

At a particular level, progressed lifting suggests publicizing went on through modernized channels, for instance, web crawlers, locale, electronic media, email, and flexible applications. Utilizing these online media channels, advanced advancing is the strategy by which affiliations ensure things, associations, and brands. Customers enthusiastically depend upon electronic intends to analyze things. Obligation publicizing is the framework for embellishment tremendous correspondences with potential and returning clients subject to the information you collect over the long haul. By drawing in clients in an electronic scene, you produce brand care, set yourself as an industry assumed pioneer, and perceive your business at the cutting edge when the client is set up to purchase. By executing an omni channel modernized showing technique, supporters can gather huge experiences into target swarm practices while making the way for new frameworks for client obligation. Plus, affiliations can need to see an augmentation in upkeep.

HISTORY OF DIGITAL MARKETING

The term Digital Marketing was first made and used in the year 1990. Around then Web 1.0 stage was made which helped customers with finding their fundamental information. This time the publicists and the experts are ignorant the businesses of mechanized advancing. They were questionable regarding if their methods would chip away at the grounds that around then the web had not yet seen certain game plan.

- In 1994, some new advances were made and entered the market with another mission. Yahoo was moreover dispatched in this year. Inside one year of its beginning, it got 1 million hits. Hurray has changed the importance of automated promoting, and the associations have endeavored to work on their destinations so they can further develop rank in web searcher.
- The essential electronic media website page Sixdegrees.com was dispatched in the year 1997.
- The year 1998 was the splendid year for electronic displaying as Google was dispatched in this year. Furthermore, in this year moreover Microsoft dispatched MSN, and Yahoo dispatched Yahoo web search.
- After two years, the web bubble burst and even more unobtrusive web lists were gotten out. This sets out more space and entryways for the beasts in the business.
- At that point, the master electronic media network LinkedIn was dispatched in 2002.
- In 2004, Gmail was dispatched. That very year Facebook has gone live, and Google opened up to the world.
- Then, YouTube was dispatched in the year 2005.
- The year 2006 was one more fundamental year since web search instrument traffic was addressed to have made to about 6.4 billion in a solitary month. This year Microsoft dispatched a MS live pursuit and, in the meantime, Twitter was besides dispatched. Simultaneously, Amazon web business deals have crossed close about $10 billion.
- In 2007, Tumblr was dispatched. Plus, electronic component Hulu was in like manner set up in this year. Adaptable beast Apple dispatched its iPhone around a similar time.
- In 2009, Google dispatched Instant for progressing web searcher results. Google introduced things like AdWords, which are 3-line commercials that show up at the top or aside of web crawler results, and AdSense which is a cost for each snap advancing arrangement.
- In 2010, WhatsApp was dispatched close by Google Buzz.
- In 2011, Google+ and Google Panda were dispatched. People have successfully started to contribute energy on these mediums, and these mediums have beated the TV viewership also.
- In 2014, the amount of adaptable and mobile phone customers had beated the amount of PC customers. Facebook messenger application close by tweaked ads on LinkedIn and iWatch was dispatched. During this year, Facebook acquired WhatsApp.

- In 2015, Snapchat has dispatched its Discover incorporate. In this year a couple of new advances like assessment, wearable tech, and substance displaying have also made. Facebook has moreover dispatched its "Second articles" in this year.
- The usage of the treat has changed all through the long haul, and treats today are coded to offer promoters a grouping of ways to deal with assemble demanding customer data.

DIGITAL MARKETING CATEGORIES

We understand there's many sorts of computerized promoting, yet driving advanced advertising master the hypothesis that all advanced showcasing falls into 11 classes as mentioned in the figure 1.

1. Search Engine Marketing (SEM)
2. Search Engine Optimization (SEO)
3. Pay-per-click (PPC)
4. Social Media Marketing (SMM)
5. Content Marketing
6. Email Marketing
7. Influencer / Affiliate Marketing
8. Viral Marketing
9. Radio Advertising
10. Television Advertising
11. Mobile Advertising

Search Engine Marketing (SEM)

SEM or Search Engine Marketing is generally considered to cover both PPC and SEO work. Securing traffic to your website through web search apparatuses is no basic task, that is the explanation SEO and PPC work to research getting said traffic through both paid and ignored strategies. PPC paid publicizing, and SEO, which manages gaining regular traffic. Watchwords lay at the middle foundations of any web search instrument promoting system. The expressions ought to be ones that your arranged customers are practically sure to use when making a request question.

Search Engine Optimization (SEO)

SEO is the most common way of improving the substance, specific course of action, and reach of your website, with the objective that your pages appear at the most noteworthy place of a web search instrument result for a specific game plan of expression terms. While PPC and retargeting have their place, normal online traffic acquired through website plan improvement has colossal impact on search rankings and, in like manner, regular page traffic. By using watchwords and articulations, you can use SEO to colossally assemble detectable quality and start a suffering customer relationship. Web advancement is described as extending a webpage's situation in online rundown things, and likewise its normal site traffic, by using standard expressions and articulations.

Today, the principle parts to consider while further developing a site page include:

- ✓ Quality of substance
- ✓ Level of customer responsibility
- ✓ Mobile-kind demeanor
- ✓ Number and nature of inbound associations

The fundamental usage of these parts makes SEO a science, anyway the unconventionality included makes it a craftsmanship. In SEO, there's no quantifiable rubric or solid norm for situating uncommonly.

Pay - Per - Click (PPC)

Paid pursuit, or pay-per-click (PPC) publicizing, typically suggests the upheld result on the top or web index results page (SERP). These advancements can be incredibly convincing, as they rely upon data accumulated from

individuals' online direct and are used to assist webpage with dealing by passing on critical commercials to the ideal people at the ideal time. These advancements in like manner incorporate retargeting, inferring that depending upon the customers' exercises, exhibiting robotization devices can make striking, singular cross-stage promotions. Pay-per-snap, or PPC, is posting an advancement on a phase and paying each time someone taps on it.

A computation centers around each available ad reliant upon different components, including:

- ✓ Ad quality
- ✓ Keyword importance
- ✓ Landing page quality
- ✓ Bid total

These exercises are known as changes, and they can be contingent or non-esteem based. Making a purchase is a change, anyway so is a flyer data trade or a call made to your work space. Whatever you pick as your goal changes.

Social Media Marketing (SMM)

The best approach to amazing on the web media advancing goes far past having dynamic electronic media accounts. The more your group is propelled to attract with your substance, the practically certain they are to share it, conceivably awakening their allies to become customers too. Online media promoting suggests driving traffic and brand care by associating with people in discussion on the web. The most standard stages for online media exhibiting are Facebook, Twitter, and Instagram, with LinkedIn and YouTube not far behind. Since electronic media publicizing incorporates dynamic group participation, it has turned into a renowned technique for standing apart enough to be taken note. It's the most standard substance mode for B2C promoters at 94%, and it's gaining ground in the B2B circle as well. According to the Content Marketing Institute, 60% of B2B content promoters extended their usage of electronic media this year.

Content Marketing

Convincing substance exhibiting isn't clearly extraordinary in nature, yet rather serves to teach and awaken customers who are searching for information. Exactly when you offer substance that is appropriate to your group, it can get you as an associated pioneer and a dependable wellspring with information, making it more questionable that your other displaying tries will be lost in the static.

Content advancing issue, and there are a ton of subtleties to exhibit it:

- ✓ 84% of customers expect that organizations ought to convey connecting with and obliging substance experiences
- ✓ 62% of associations that have at any rate 5,000 laborers produce content step by step
- ✓ 92% of promoters acknowledge that their association regards content as a critical asset

Anyway, amazing as substance advancing might be, it might be fascinating. Content exhibiting creators ought to have the alternative to rank outstandingly in web crawler results while moreover enthralling people who will examine the material, share it, and team up further with the brand.

Email Marketing

After more than twenty years, email is at this point the quickest and most direct way to deal with show up at customers with essential information. Today, productive email campaigns ought to be unbelievably enrapturing, huge, informational, and connecting with to not get canvassed in your customer's inbox. To succeed, your publicizing messages should satisfy five focus credits. They ought to be trustworthy, huge, conversational, worked with across channels, and crucial. Regardless, the execution is generously more amazing. In particular, you need to guarantee that your messages are required.

This infers having a pick in list that does the going with:

- ✓ Individualizes the substance, both in the body and in the feature
- ✓ Offers an unquestionable pull-out decision
- ✓ Integrates both worth based and exceptional messages

You need your conceivable outcomes to consider your to be as a regarded help, not comparably as a restricted time device. It might be amazingly better if you meld various strategies like displaying automation, which permits you to segment and plan your messages so they address your customer's issues even more effectively.

Affiliate Marketing

Affiliate marketing permits someone to acquire cash by propelling another person's business. You could be either the publicist or the business who works with the sponsor, yet the connection is something almost identical in any case. It works using a pay sharing model. In the event that you're the auxiliary, you get a commission each time someone purchases what you advance. In the event that you're the vendor, you pay the partner for each arrangement they help you make. Others have relationship with different dealers. Whether or not you should be a partner or find one, the underlying advance is to make a relationship with the other party. In the event that you're a retailer and you choose to work clearly with accomplices, there are various things you can do to make your program fascinating to anticipated publicists. That fuses inspirations for staggering results similarly as advancing help and pre-made materials.

Viral Marketing

To be sure, a couple of associations use those as a splendid kind of displaying. Whether or not it's working together with a popular viral substance creator, notable online media powerhouse or propelling it themselves, the chance of viral elevating is to make something share worthy by making it engaging, on design and compelling.

Radio Advertising

While radio used to be solely established on radio waves, it's at present totally electronic. Which suggests, radio advancing now falls into the area of modernized promoting. Radio ads are an extraordinary strategy to get your business or brand heard, and it's never been more straightforward to do with cutting edge publicizing.

Television Advertising

Radio isn't the solitary thing to move over to cutting edge. There are loads of options for those that need to plug on TV without paying expensive notice space costs on early evening TV. Regardless, even with the mechanized shift and social irregularity of Television Advertising, some really consider the 30-second advancement like an urgent publicizing device in the accompanying relatively few years.

Mobile Marketing

Phones are kept in our pockets, sit near our beds, and are checked constantly for the span of the day. This makes advancing on adaptable stunningly critical 66% of customers can survey a specific brand they have seen announced on convenient fairly as of late yet flexible is moreover very nuanced pondering its private nature. SMS, MMS, and in-application elevating are by and large choices to show up at your customers on their contraptions, yet past that, you ought to consider the coordination of your displaying attempts across your other progressed promoting channels.

THE BENEFITS OF DIGITAL MARKETING

Digital marketing has become conspicuous to a great extent since it contacts a wide crowd of individuals, however it offers various different benefits also. These are a couple of the advantages.

A Wide Geographic Reach

Right when you post an ad on the web, people can see it paying little mind. This simplifies it to foster your business' market reach.

Cost Productivity

Progressed displaying not simply contacts a broader group than traditional publicizing yet furthermore passes on a lower cost. Overhead costs for paper advancements, TV spots, and other standard publicizing openings can be high.

They furthermore give you less force regarding whether your expected vested parties will see those messages regardless. With cutting edge displaying, you can make just 1 substance piece that draws in visitors to your blog as long as it's dynamic. You can put forth an email advancing attempt that passes on messages to zeroed in customer records on a schedule, and it's not hard to change that arrangement or the substance if you need to do accordingly. Right when you set up everything, progressed promoting gives you significantly greater versatility and customer contact for your commercial spend.

Quantifiable Outcomes

To know whether your exhibiting method works, you need to find the quantity of customers it attracts and how much pay it finally drives. Incredibly, that doesn't work in all endeavors. Various associations don't will have one-on-one conversations with their customers, and audits don't for the most part get all out results. Electronic exhibiting programming and stages normally track the number of needed changes that you get, whether or not that suggests email open rates, visits to your presentation page, or direct purchases.

Simpler Personalization

Progressed elevating licenses you to collect customer data in a way that detached promoting can't. Data accumulated cautiously will overall be extensively more precise and unequivocal. Imagine you offer financial organizations and need to pass on unprecedented recommendations to people who have looked at your things. One is for energetic families who have looked at your additional security things, and the other is for millennial business visionaries who have considered your retirement plans.

More Association with Clients

Progressed elevating permits you to talk with your customers continuously. Even more basically, it permits them to talk with you. Consider your online media procedure. It's fantastic when your expected vested party sees your latest post, anyway it's far prevalent when they comment on it or offer it. It suggests more buzz enveloping your thing or organization, similarly as extended detectable quality each time someone joins the conversation. Insight helps your customers as well. That sensation of ownership can make a strong sensation of brand faithfulness.

Simple and Helpful Changes

Progressed displaying permits your customers to take an action following audit your ad or substance. With traditional ads, the speediest result you can expect is a call not long after someone sees your notice. With cutting edge advancing, they can click an association or save a blog section and move along the business channel right away. They likely will not make a purchase immediately, yet they'll remain related with you and permit you to associate with them further.

TRADITIONAL Vs MODERN MARKETING

Traditional Marketing

Traditional marketing has been used and savored the experience of by people wherever on the world, so it's nothing sudden that everyone thinks about this thought. It's similarly planned to focus in extra on selling a particular assistance or thing and uses a grouping of mediums to broadcast a brand. Because of these components, standard exhibiting is more self-evident, and associations won't experience any difficulty explaining their thing or organization to various age social occasions. Likely the most typically used standard displaying systems fuse the going with.

Business Cards

This sort of customary promoting technique is a speedy route for an organization or individual to spread their data. Accordingly, it'll perpetually persevere through the consistently changing promoting system scene.

Television and Radio Promotions
A great many individuals check out the radio each day, so promoting an item or administration through this channel actually works.

Flyers and Leaflets
Flyers and leaflets are intended to catch the consideration of a wide crowd. They normally utilize lively tones to pass on a message or show a picture the peruse can undoubtedly recollect.

Bulletins and Signage
Utilizing outside boards and signage are extraordinary approaches to publicize a business to day-by-day drivers, workers, and individuals who are strolling around the city.

Post Office-Based Mail
This customary promoting methodology is utilized to spread consciousness of a specific item or administration to a particular objective market. It utilizes a mail administration to convey special printed pieces like postcards, leaflets, and letters.

Modern Marketing
While customary advertising's point of convergence is the organization's item or organization, current exhibiting is more customer arranged. Associations that get this procedure reliably put their customers' satisfaction paying little mind to whatever else, so they're prepared to address their group's extraordinary necessities and requirements. Since present day promoting uses a high-level stage, it's more customizable. It can in like manner successfully conform to change, so it has no issue remaining mindful of the latest publicizing designs. These parts assist with collecting customer endurance and trust, similarly as generally brand affirmation. The going with models is irrefutably the most well-known current publicizing procedures used today.

Email Promoting
People peruse their messages on different events daily, so email displaying is an extraordinary system to advance a thing. In any case, this works best with individuals who have successfully attracted with the brand.

Web Promotions
There are a lot of sites and online stages willing to show ads at a cost. Google promotions and YouTube video promotions, for instance, are two enormous publicizing stages that can promote a specific item or administration to high-focused on crowds.

Internet Business Websites
Making an internet business site is a viable path for individuals to helpfully study a brand's item. By sharing the site's URL, individuals who click on the connection are immediately brought to the online business site where they can look through the pages and take a gander at the brand's contributions.

Utilizing Online Media Destinations Like Facebook, Twitter, And Instagram.
Online media sites have an implicit information examination apparatus that empowers brands to watch out for their prosperity, commitment, and promotion crusades. It's additionally simpler to make a buzz utilizing Facebook, Twitter, or Instagram because of internet advertising patterns like utilizing hashtags.

BENEFITS OF DIGITAL MARKETING
Benefits and Disadvantages of Digital Marketing influence your business obviously. What's more, you realize that computerized promoting benefits organizations of all sizes by offering admittance to the mass market at a moderate

cost. Dissimilar to TV or print publicizing, it permits genuinely customized promoting. The main categories are mentioned in the figure 2.

Significance

Helps you with creating better salaries. Close by better change rates made by successful mechanized advancing techniques, progressed promoting similarly ensures uncommon wages. It passes on heaps of helpful advantages for you and your business prefers better and higher wages.

Brand Development

Presence on the web can help the improvement of the relationship from any typical market to the nation over and as a rule business networks meanwhile, giving in every practical sense, limitless progression openings.

Available All Day, Every Day

The web never rests accordingly does online advancement, enabling business with little sources to keep up genuine 24-hour abilities to fight in the electronic business using on the web development resources that can run for all intents and purposes 24 hours dependably and 7 days out of consistently. consequently, this is in like way one of the potential increases of motorized publicizing.

Simple to Measure

Web everything can be settled, in this way it's less eccentric for the relationship to know immediately if their strategy is working or not, what association or client is eager about their things, from what spots or countries are they, and so on

Diminished Cost

It empowers the relationship to save cash, a segment that is genuinely considered by the relationship since the undeniable level appearance systems needn't mess with a gigantic heap of budgetary commitment.

- ✓ Extremely lower hazard.
- ✓ Reduction in costs through robotization and use of electronic media.
- ✓ Opens the Possibility to A Market of One Through Personalization.
- ✓ Increased Interactivity.
- ✓ Increased transparency of things and organizations.
- ✓ Boundless transparency.
- ✓ Real-time customer advancing and input.
- ✓ Real-time social sharing and uncovering of restricted time or another media content.
- ✓ Complimenting existing progressed establishment like destinations through agreeable media.
- ✓ Targeted receptiveness in the associations you pick.
- ✓ More exact after and seeing of your undertakings and missions.
- ✓ Potential for business in effectively non-researched organizations and target markets.
- ✓ Demographically centered around receptiveness in new and existing target business areas.
- ✓ Broadening of for the most part business potential and development in transparency.

WEAKNESS OF DIGITAL MARKETING

Progressed Strategy Can Be Copied

One of the risks in web publicizing is that a specific system can without an entirely amazing stretch be repeated by a foe. Pictures can be utilized to hoodwink clients and take out a significant business from you. not just that, these can likewise be utilized for executing antagonistic and wrong data about your thing, things or associations that will hurt your online standing and diminishing huge centered clients.

Automated Marketing Includes Too Much Competition

Similarly, as the improvement of online promotions, web headway is proficient about a unimaginable technique of an enormous number of competitors. Automated sponsors are not fit for getting into an even more predominant spot for the best show for their headway and progression endeavors, and with the usage of an unnecessary number of competitors, will make it extensively dynamically inconvenient and exorbitant to get the energy of centered watchers.

Security Issue

Web exhibiting has its own special shortcomings which are not distinguishable on its experience regard. thusly, for an individual or client who questions online for things or organizations. There is an alarm not to reveal all the private information as it very well might be used against them by unidentified people. thus, this is in like manner one of the bothers of computerized promoting

Nonappearance of Trust

One of the enormous hindrances may be an insufficiency of taking confidence in of the customers. due to could be prohibitive interesting offers that emit an impression of being comedians. Along these lines, this is a part that rots the picture and dependability of significant worth and genuine associations.

Requires More Initial Investment

Playing progressed progressing contains unmistakable confinements like making sensitive and expert searching for your site and coordinating a reasonable framework. in this manner, paid displaying like chase motors AdWords, web crawlers' commercials, and online media exhibiting is costly.

- ✓ Dependability on advancement
- ✓ Security, security issues
- ✓ Maintenance costs because of a ceaselessly creating environment.
- ✓ Higher straightforwardness of assessing and extended worth contention.
- ✓ Worldwide contention through globalization.
- ✓ Real-time customer complaints and analysis.
- ✓ Increased usage of business and individual resources for direct and control your web- based media campaign.
- ✓ Training and capacity imperative to direct online media to the ideal.
- ✓ Your progressed impression ends up being a great deal to manage go to negative on the web reputation.
- ✓ Negative delegate influence inside and distantly to your business.

CONCLUSION

Progressed publicizing has end up being basic piece of approach of different affiliations. It has no limitations. Affiliation can use any gadgets, for example, tablets, advanced cells, TV, workstations, media, online media, email and part other to help affiliation and its things and associations. Electronic Marketing is fundamental for experts in forefront showing. Electronic publicizing is an optimal business opportunity for state-of-the-art advertisers. To be completely serious on the automated market, you need to have a reasonable impression of the benefits and hindrances of forefront showing. This is a making business field. Modernized displaying is basically abusing new advances to accomplish publicizing targets. Progressed exhibiting may satisfy all your venerated dreams inside the limited capacity to focus your life. Advanced advancing is where anyone can make their vocation without a particularly extraordinary arrangement of exertion.

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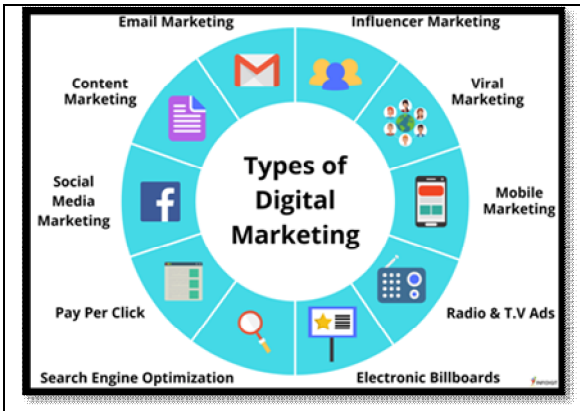

Fig. 1. Classes of Digital Marketing

Fig. 2. Benefits & Weakness of Digital Marketing

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RESEARCH ARTICLE

The Antioxidant Study of One Ayurvedic Formulation Madhukasavam

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ABSTRACT

The present study deals with the anti-oxidant test of Ayurvedic medicine Madhukasavam. Madhukasavam is a polyherbal Ayurvedic medicine useful in treating grahni (malabsorption syndrome), skin diseases, and wasting syndrome. The present study was to understand the antioxidant capacity of this medicine and the study consisted of four types of antioxidant assays namely, DPPH, FRAP, ABTS and Hydrogen peroxide scavenging activity. It was observed that in all the four assays the medicine showed promising antioxidant activities. the IC_{50} value for ABTS radical scavenging effect of Madhukasavam was found to be 43.3 µg/ml and Ascorbic acid was 19.5 µg/ml. The IC_{50} value for DPPH radical scavenging assay of Madhukasavam and Ascorbic acid was found to be 57.3 µg/ml and 20.23 µg/ml**,** respectively which is obtained from table 2**.** The IC_{50} value for FRAP assay of Madhukasavam from table 3 was found to be 65.82 µg/ml and Ascorbic acid was23.45 µg/ml. The IC_{50} value for Hydroxyl radical scavenging activity obtained from table 4, where 67.5µg/ml and 19.37µg/ml are the IC_{50} of

Madhukasavam and Ascorbic acid, respectively. These results indicate that one of the roles of this medicine could be through its antioxidant potential.

Keywords: Madhukasavam, Antioxidant, DPPH, FRAP, ABTS, Hydrogen peroxide.

INTRODUCTION

Ayurvedic and siddha medicines are the traditional and age old medical practices of India. Due to the modern medicine these forms of medical practices have become the back benchers. There is an implied need to resurrect these forms of treatment due to the simple fact that they are easily available, cost effective and considered to have lesser side effects. The modern medicine, although effective, is beset with negative aspects like side effects, costly and not available to masses easily. Since last two decades some studies have been done to prove the medicinal efficacy of Ayurvedic and siddha formulations in the light of modern scientific techniques. This trend must continue to establish the age old systems back to their glory. There are quite a number of reports of the antioxidant activity studies of Ayurvedic medicines. The antibacterial, antioxidant activity and GC MS analysis of siddha medicine "neerkovai tablets" was studied by Ravi *et al,* 2015 [1]. The GC-MS analysis, antimicrobial, antioxidant activity of an Ayurvedic medicine "nimbapatradichoornam" was reported by Chandrasekar *et al,* 2015 [2].Effect of *Premna tomentosa* on rat liver antioxidant defence system in acetaminophen intoxicated rats was reported by Devi *et al,* 1998 [3]. Preliminary phytochemical, antioxidant and antimicrobial activities of different extracts of *Cassia tora*and *Trichodesmaindicum* was reported by Rao*et al,* 2016 [4]. Antioxidant study and GC MS analysis of an Ayurvedic medicine "Talisapatradi Choornam" was studied by Rao*et al,* 2016 [5]. Antioxidant assay and GC MS analysis of one siddha medicine "Swasa Kudori tablets" was reported by Rao*et al,* 2016 [6]. Preliminary phytochemical analysis and antioxidant properties of *Gynandropsis pentaphyla* was reported by Rao*et al,* 2015 [7]. GC-MS analysis, antimicrobial, antioxidant activity of an Ayurvedic medicine, *Salmali Niryas* was reported by Rao*et al,* 2015 [8]. Antioxidant study of one Ayurvedic medicine, "Sukumara Kashayam" was reported by Nirupa*et al,* 2017 [9]. Evaluation of antioxidant and hepatoprotective potential of *Premna tomentosa* L. in Albino Wistar Rats was studied by Pawar*et al,* 2016 [10]. The GC-MS and antioxidant study of an Ayurvedic Medicine "Ayaskriti" was reported by Rao*et al,* 2017 [11]. GC MS Analysis and antioxidant studies of an Ayurvedic drug "Partharishtam" was reported by Sadhanandham *et al,* 2015 [12]. The antioxidant study of an Ayurvedic medicine "Balarishtam" was studied by Konda*et al,* 2017 [13]. Preliminary GC-MS Analysis and Antioxidant Study of one Ayurvedic Medicine "Manasa Mitra Vatakam" was reported by Sivakumaran *et al,* 2016 [14]. Prabhu *et al*, 2020 have reported the antioxidant potential of Mahanarayanathailm, a pain reliving oil [15] Prabhu *et al,* 2020 also have reported the antioxidant role of another Ayurvedic medicine, Drakshadikashayam [16]. Vijayalakshmi and Rao, 2020, have reported the antioxidant role of one medicinal plant, *Vitex negundo* [17]. Kumar *et al*, 2020, have reported the antioxidant role of one Ayurvedic medicine, Kutajarishtam [18]. The present work deals with the antioxidant study of Ayurvedic medicine Madhukasavam useful in treating grahni (malabsorption syndrome), skin diseases and wasting syndrome.

MADHUKASAVAM

Madhukasavam is prepared from cold infusions or juice of medicinal herbs in the following method: *Madhuca indica* flowers (12.288 kg), *Embelia ribes* fruit (6.144 kg), *Plumbago zeylanica* Roots, *Semicarpus anacardium* fruits (3.072 kg) and *Rubia cordifolia* roots (384 g) are boiled in 36.864 L of water and the decoction is reduced to 12.288 L. To this decoction, honey (1.536 kg) is added. Sufficient quantities of *Elettaria cardamomum* seeds, *Nelumbium speciosum* stem, *Aquilaria agallocha* heart wood and *Santalum album* heartwood are added to the above mixture and allowed to ferment for 1 month in a special vessel. The final product is filtered and used as medicine. This drug is taken 12–24 ml with an equal amount of water after meals, twice a day or as directed by a physician.

MATERIALS AND METHODS

Sample collection

The sample Madhukasavam was collected from the Kottakkal Arya Vaidhiya Sala, Chennai.

Antioxidant Activity

ABTS Assay

ABTS radical cation was produced by the reaction of a 7 mmol/L ABTS solution with 2.45 mmol/L potassium persulphate. The mixture was stored in the dark at room temperature for 12 h before use. The ABTS+ solution was diluted with ethanol to an absorbance at 734 nm. After addition of 25 μL of sample or standard to 2 mL of diluted ABTS+ solution, absorbance at 734 nm was read after 6 min. A standard curve was prepared by measuring the reduction in absorbance of ABTS•+ solution at different concentrations of test sample. Appropriate blank measurements were carried out and the values recorded. Ascorbic acid was used as positive control

DPPH assay

The antioxidant activity of the Madhukasavam sample was estimated on the basis of the radical scavenging effect of the stable DPPHi. Various concentrations of the test sample were added to a methanolic 0.4 mM DPPHi solution (0.1 ml) in a 96 well plate. The reaction mixture was shaken vigorously and allowed to stand for 30 min at 37°C. The degree of DPPHi purple decolorization to DPPH yellow indicated the scavenging efficiency of the test sample. The absorbance of the mixture was determined at 517 nm using UV-Vis microplate reader and Quercitin was served as a positive control. The scavenging activity against DPPHi was calculated using the following equation: Scavenging activity (%) = [1 - (A1 - A2) / A0] x 100% where A0 was the absorbance of control (DPPHi solution without the test sample), A1 was the absorbance of DPPHi solution in the presence of the test sample and A2 was the absorbance without DPPH· solution.

FRAP Assay

The method is based on the reduction of Fe^{3+} TPTZ complex (colorless complex) to Fe^{2+}-tripyridyltriazine (blue colored complex) formed by the action of electron donating antioxidants at low pH. This reaction is monitored by measuring the change in absorbance at 593 nm. The Ferric reducing antioxidant power (FRAP) reagent was prepared by mixing 300 mM acetate buffer, 10 ml TPTZ in 40 mM HCl and 20 mM $FeCl_3.6H_2O$ in the proportion of 10:1:1 at 37°C. Freshly prepared working FRAP reagent was pipetted using 1-5 ml variable micropipette (3.995 ml) and mixed with 5 μl of the appropriately diluted plant sample and mixed thoroughly. An intense blue color complex was formed when ferric tripyridyltriazine (Fe^{3+} TPTZ) complex was reduced to ferrous (Fe^{2+}) form and the absorbance at 593 nm was recorded against a reagent blank (3.995 ml FRAP reagent+5 μl distilled water) after 30 min incubation at 37°C. All the determinations were performed in triplicates. The concentrations of $FeSO_4$ were in turn plotted against concentration of standard antioxidant trolox The FRAP values were obtained by comparing the absorbance change in the test mixture with those obtained from increasing concentrations of Fe3+ and expressed as mg of Trolox equivalent per gram of sample.

Hydrogen peroxide scavenging activity

Hydroxyl radical scavenging activity was measured by the ability of the test sample to scavenge the hydroxyl radicals generated by the Fe3+ -ascorbate-EDTA-H2O2 system (Fenton reaction).The reaction mixture in a final volume of 1.0 ml contained 100 μl of 2-deoxy-D-ribose (28 mM in 20 mM KH_2PO_4 buffer, pH 7.4), 500 μl of the test sample at various concentrations (50–800 μg/ml) in buffer, 200 μl of [1.04 mM EDTA and 200 μM $FeCl_3$] (1:1v/v), 100

µl of 1.0 mM hydrogen peroxide (H_2O_2) and 100 µl of 1.0 mM BHT used as a positive control. Test samples were kept at 37°C for 1 h. The free radical damage imposed on the substrate, deoxyribose, was measured using the thiobarbituric acid test. One ml of 1% thiobarbituric acid (TBA) and 1.0 ml 2.8% trichloroacetic acid (TCA) were added to the test tubes and were incubated at 100°C for 20 min. After cooling, the absorbance was measured at 532 nm against a blank containing deoxyribose and buffer. BHT (50–1000 µg/ml) was used as positive controls.

Statistical analysis

Results are expressed as mean ± S.E.M. Statistical significance was determined by one-way analysis of variance (ANOVA), followed by Dunnett's multiple-comparison test with 95% confidence intervals. P values less than 0.05 was considered significant.

RESULTS AND DISCUSSION

The standard drug Ascorbic acid were used as standard for ABTS, DPPH, FRAP and Hydroxyl radical scavenging activity antioxidant assay. It was carried out in order to have better comparative study with Madhukasavam. The concentrations of Madhukasavam were10, 25, 50 and 100 µg/ml for all antioxidant assays, where ascorbic acid was taken in 5, 10, 25 and 50 µg/ml since it is found that if standard exceeds 50 µg/ml, it reached maximum absorbance value. So, in all antioxidant assays, the standard concentration are taken at range of 5-50 µg/ml to have better comparative study. The average value of the reactions performed in triplicate was obtained and plotted against the different concentrations of Madhukasavam and its standards. The IC50 value, that is half maximal inhibitory concentration, was calculated from R^2 equation obtained from linear thread line from the respective graph of concentration of Madhukasavam/ standard against % inhibition values.

From Table 1, the IC_{50} value for ABTS radical scavenging effect of Madhukasavam was found to be 43.3 µg/ml and Ascorbic acid was 19.5 µg/ml. The IC_{50} value for DPPH radical scavenging assay of Madhukasavam and Ascorbic acid was found to be 57.3 µg/ml and 20.23 µg/ml, respectively which isobtained from Table 2. The IC_{50} value for FRAP assay of Madhukasavam from table 3 was found to be 65.82 µg/ml and Ascorbic acid was 23.45 µg/ml. The IC_{50} value for Hydroxyl radical scavenging activity obtained from table 4, where 67.5 µg/ml and 19.37 µg/ml are the IC_{50} of Madhukasavam and Ascorbic acid, respectively. From the IC_{50} value results mentioned above, it is clear that among sample and standard, standard is obvious to show more antioxidant potential then sample. The comparative graphical representation of percentage inhibition activity of various concentration of sample (10, 25, 50 and 100 µg/ml) vs. standard concentration (5, 10, 25 and 50 µg/ml) was given in table 1-4 are ABTS, DPPH, FRAP and Hydroxyl radical scavenging activity, respectively.

Thus, these results indicate the genius of the age old medical practioners of Ayurveda. This may be due to the presence of flavonoids present inMadhukasavam. The result indicates that Madhukasavam have good antioxidant activities which could be contributing factors for their medicinal roles. From the above studies it is clear that for all the four antioxidant studies Madhukasavam showed better results as compared to the respective standard controls. These results clearly indicate that the medicinal role of Madhukasavam could be due to its strong antioxidant potential.

CONCLUSION

It is concluded that Madhukasavam has excellent antioxidant activity which could contribute to its medicinal role.

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Table 1: Percentage inhibition of ABTS radical scavenging activity of Madhukasavam and Ascorbic acid

SL.No	Conc (µg/ml)	% Inhibition of ABTS radical scavenging activity	
		Madhukasavam	Ascorbic acid
1	5	-	19.6
2	10	11.49	42.5
3	25	49.19	69.3
4	50	68.73	84.5
5	100	78.16	-
IC50 value(µg/ml)		**43.33**	**19.5**

Table 2: Percentage inhibition of DPPH radical scavenging activity of Madhukasavam**and Ascorbic acid**

SL.No	Conc (µg/ml)	% Inhibition of DPPH radical scavenging activity	
		Madhukasavam	Ascorbic acid
1	5	-	20.9
2	10	19.53	43.1
3	25	30.8	64.2
4	50	44.1	83.2
5	100	77.5	-
IC50 value(µg/ml)		**57.3**	**20.23**

Table 3: Percentage inhibition of FRAP assay of Madhukasavam**and Ascorbic acid**

SL.No	Conc (µg/ml)	% Inhibition of FRAP assay	
		Madhukasavam	Ascorbic acid
1	5	-	19.5
2	10	16.05	36.5
3	25	23.7	58.1
4	50	49.1	81
5	100	66.4	-
IC50 value(µg/ml)		**65.82**	**23.45**

Table 4: Percentage inhibition of Hydroxyl radical scavenging activity of Madhukasavam and Ascorbic acid

SL.No	Conc (µg/ml)	% Inhibition of Hydroxyl radical scavenging activity	
		Madhukasavam	Ascorbic acid
1	5	-	21.2
2	10	18.88	44.2
3	25	22.2	66.6
4	50	43.2	83.8
5	100	67.5	-
IC50 value(µg/ml)		**67.5**	**19.37**

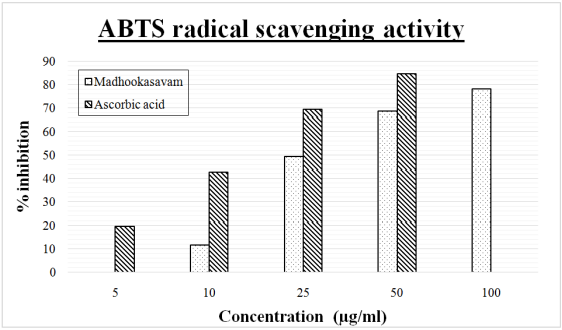

Figure 1: Comparative graphical representation ofABTS radical scavenging activity of Madhukasavam **and Ascorbic acid**

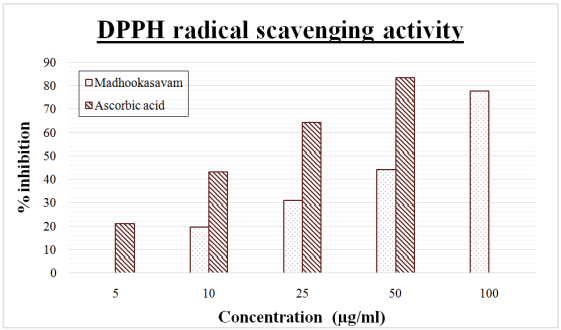

Figure 2: Comparative graphical representation of DPPH radical scavenging activity of Madhukasavam **and Ascorbic acid**

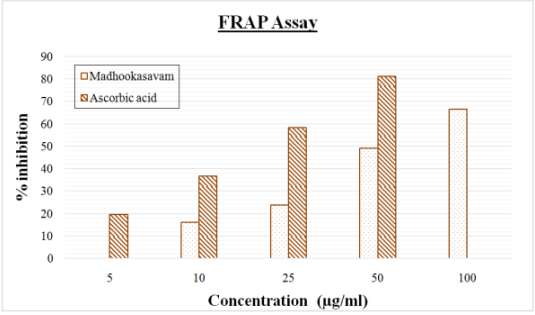

Figure 3: Comparative graphical representation of FRAP assay of Madhukasavam and Ascorbic acid

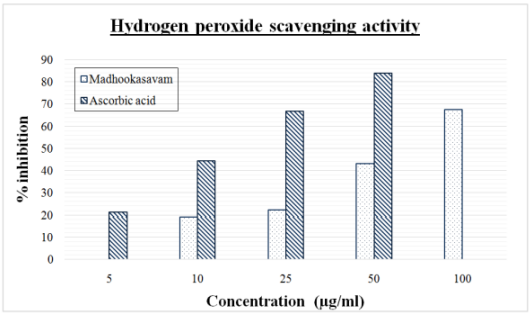

Figure 4: Comparative graphical representation of Hydroxyl radical scavenging activity of Madhukasavam and Ascorbic acid

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REVIEW ARTICLE

A Review on Reverse Phase - High Performance Liquid Chromatography

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ABSTRACT

HPLC is the influence over the other separation technique to detect, separate and quantify the drug. A number of chromatographic (HPLC) parameters were analyzed and necessary to optimize the method like sample pre-treatment, choosing mobile phase, column, and detector selection, efficiency factor, the retention factor and the separation factor. The representing facts of this article is to review the method development, optimization, and validation. In this chromatographic method (HPLC) measures the concentration of active pharmaceutical ingredients (AP)in a dosage form, development depends on the chemical structure of the molecules, synthetic route, solubility, polarity, pH and pKa values, and functional group activity, etc. Validation of the HPLC method as per ICH Guidelines gives information regarding various stages and knowing characteristics like Accuracy, specificity, linearity limit of detection(LOD), limit of quantification(LOQ), recovery and ruggedness/robustness.

Keywords: High-Pressure Liquid Chromatography (HPLC), Method validation, Method development

INTRODUCTION

HPLC is a powerful tool in analytical chemistry. It has the ability to separate, find, and quantify the compounds that are present in any sample that can be dissolved in a liquid. HPLC is the most accurate analytical method widely used for the quantitative as well as qualitative analysis of drug products. The principle is that a solution of the sample is injected into a column of a stationary phase and a mobile phase is pumped at high pressure through the column. The separation of sample is based on the differences in the rates of migration through the column arising from the different partitions of the sample between the stationary and mobile phases. Depending upon the partition behavior of different components, elution at a different time takes place. The sample compound with the greater affinity to the stationary layer will travel slower and for a shorter distance in comparison to compounds with less affinity which travel faster and for a longer distance. He High-Performance Liquid Chromatography is more able to more adapt than gas chromatography since (a) it is not limited to volatile and thermally stable samples, and (b) the choice of mobile and stationary phases is wider.

HPLC has numerous advantages like

- Simultaneous Analysis
- High Resolution
- High Sensitivity
- Good repeatability
- Small sample size
- Moderate analysis condition.
- Easy to divide in to components of the sample and purify.

Classification of HPLC

- Preparative HPLC and analytical HPLC (based on the scale of operation)
- Affinity chromatography, adsorption chromatography, size exclusion chromatography, ion-exchange chromatography, chiral phase chromatography (based on the principle of separation)
- Two type of the separation method in the first one is Gradient separation and second one is isocratic separation, (based on elution technique)
- Normal phase and reverse-phase chromatography (based on modes of operation)

Normal phase chromatography: In normal phase chromatography has two type of the phases, the stationary phase is polar and the mobile phase is non-polar. Hence, the stationary phase retains the polar analyte in this chromatography. An increase (↑) in polarity of solute molecules increases (↑) the adsorption capacity leading to an increased (↑) elution time. Chemically modified silica (cyan propyl, amino propyl, and diol) is used as a stationary phase in this chromatography. [7] For example. A column has an internal (inside column) diameter of around 4.6 mm, and a length in the range of 150 to 250 mm. The mixture of the polar compound that are passed through the column will stick longer to the polar silica and the non-polar compound passed through the column has less affinity. Therefore, the -polar ones will pass more quickly through the column. [8]

B.RP-HPLC (Reversed-phase HPLC): RP-HPLC is based on the principle of hydrophobic interaction (HIC)-low water soluble compounds [9].

HPLC method development steps

1. Selection of chromatographic conditions.
2. Sample preparation
3. Method optimization
4. Method validation

Selection of chromatographic conditions

- Selection column
- Buffer selection
- Buffer concentration

Isocratic and Gradient Separations: Isogratic and gradient HPLC system

The mainly difference between the isocratic and gradient systems is that the isocratic elution uses - a single mobile phase composition having the same polarity, whereas the gradient elution uses - more than one mobile phase and it can gradually increase(↑) or decrease(↓) the polarity of the mobile throughout the process of separation. The gradient mode of separation includes significantly increases the separation power of a system mainly due to the increase of the apparent efficiency (decrease of the peak width). The rate of the eluent composition variation Peak width is dependent on the eluent composition. A starting with the initial gradient run is performed and the ratio between the total gradient time and the difference in the gradient time between the first and last component are calculated. The calculated ratio is <0.25 isocratic is adequate. When the ratio is >0.25 gradient would be adequate [10]

Selection of column: The most important step in method development is selection of stationary phase/column.In this A C8 or C18 column made from specially purified, less acidic silica and designed specifically for the separation of basic the most important step in method development is the selection of the stationary phase/column is the first. A C8 or C18 column made from specially purified, less acidic silica and designed specifically for the separation of basic compounds are generally suitable for all samples and is strongly recommended[10].The different Column dimensions, silica substrate properties, and bonded with the stationary phase characteristics are the main ones. The use of silica-based packing is favored in most of the present HPLC columns due to several physical characteristics. [11]

Buffer Selection

General consideration for buffer selection

1. Some salt buffers are hygroscopic and this may lead to changes in the chromatography like increased tailing of basic compounds and possibly selectivity differences in the analytical processes.
2. Trifluoroacetic acid can degrade with time. It is absorbs and volatile at low UV wavelengths.
3. Coloumn inside the Microbial growth can quickly occur in buffered mobile phases that contain little or no organic modifier at all. The microbial growth of accumulates on column (essential and necessary product of microbes) inlets and can damage chromatographic performance.
4. At a pH greater than 7(pH>7), phosphate (PO_4^{3-}) buffer accelerates the dissolution of silica and severely shortens the lifetime of silica-based HPLC columns. If possible, organic buffers should be used at a pH greater than 7.
5. Ammonium bicarbonate (NH4HCO3) buffers usually are prone to pH changes and are usually stable for only 24-48hrs.
6. After buffers are prepared, they should be filtered through a 0.2-μm filter.
7. Mobile phases should be degassed. [12]

Buffer concentration: The small molecules a buffer concentration of 10-50 mM. A buffer of is 50% organic solvent should be used in the buffer solution. This will depend on the specific buffer (depend on the concentration).The most common buffer systems (Phosphoric acid and its sodium or potassium salts) for reversed-phase HPLC. Sulfonate buffers alternate to phosphonate buffers when analyzing the compounds. [13]

Internal Diameter: The internal diameter (ID) of the HPLC column detection sensitivity and separation selectivity in gradient elution. It also determines the quantity of analyte that can be loaded into a column. [14]

Particle size: HPLC is performed with the phase (stationary phase) attached to the outside of small silica particles. These silica particles size with 5 μm beads being the most commonly used. [15-16] (Smaller particles and larger particles).

Pore size: The pore size of column defines an ability of the analyte molecules to penetrate inside the particle and interact with its inner surface [17]

Selection of Mobile Phase: The phase (mobile phase) effects resolution, selectivity, and efficiency. The phase (Mobile phase) composition (or solvent strength) plays an important role in RP-HPLC separation. Acetonitrile (ACN) methanol (MeOH) and tetrahydrofuran (THF) are commonly used solvents in RP-HPLC having a UV cut-off of 190, 205 and 212nm respectively. These solvents are miscible with water. The mixture of acetonitrile and water is the best initial choice for the mobile phase during method development [18]. In the analytical method of HPLC using Detector is a very important part of HPLC. Selection of detector depends on the chemical nature of analyses, potential interference, limit of detection required, availability and/or cost of detector. Ultra violet (UV) visible detector is versatile, dual wavelength absorbance detector for HPLC. This detector offers the very high sensitivity required for routine ultra violet (UV)-based applications to low-level impurity identification and quantitative analysis of the analytical method. Photodiode Array (PDA). Detector offers advanced optical detection for Waters analytical method of the HPLC method, preparative HPLC method, or LC/MS system solutions. Its integrated software and optics innovations deliver high chromatographic method and spectral analytical method sensitivity analyzed. Refractive index chromatographic and spectral sensitivity, stability and reproducibility, which make this detector the ideal solution for analysis of components with limited or no UV absorption. Multi-wavelength Fluorescence Detector offers high sensitivity and selectivity fluorescence detection for quantitating low concentrations of target compounds [19-20]. Sample preparation is a necessary part of HPLC analysis in the analytical method, intended to provide a solution that is suitable for injection on to the column. The aim of sample preparation free of interferences Will not damage the column, and is compatible with the intended HPLC method that is, the analyze solvent will dissolve in the mobile phase without affecting sample resolution. Sample preparation begins at the point of collection, extends to sample injection onto the HPLC column. [21]

Method optimization: Identify the "weaknesses" of the method and optimize the method through experimental design. [22]

Method validation: Validation is the provision of important objective evidence that the particular requirements for specific intended use are fulfilled method of the HPLC method. A process of evaluating method performance a particular requirement. In this analytical method essence for, it knows what your method is capable of delivering, particularly at low concentrations. [23]

The validation of analytical procedures for the four types of analytical procedures commonly:

- Identification tests in the analytical method;
- Quantitative tests for impurities' content in the analytical method;
- Limit tests for the control of impurities in the analytical method;
- Analytical method of the Quantitative tests of the very active moiety in samples of a drug substance or drug product or other selected component(s) in the drug product. [24]

Components of method validation

The following are typical analytical performance of the characteristics which may be tested during the methods validation:

1. Accuracy
2. Precision
3. Linearity
4. Detection limit
5. Specificity
6. Range
7. Robustness

Accuracy: Accuracy is defined as the nearness value to the true or accepted value. Practically the deviation between the mean value found and the true value. It is determined by the method to samples to which known amounts of analyte have been added. These analyzed against the standard and blank solutions to ensure that no interference exists. The accuracy is the test results as a percentage of the analyte recovered by the assay. It may often be expressed as the recovery by the assay method of known and, added amounts of analyte. [25]

Precision: It expresses the closeness of measurements obtained from multiple sampling of the same homogeneous sample under the prescribed conditions. Precision is a measurement of the whole analytical method. [26] It consists of repeatability and intermediate precision. Validation is important in the analytical method, repeatability is performed by analyzing an assay composite sample by using the analytical method. The recovery value is calculated. Intermediate precision is the variation such as different days, with different instruments, and by different analysts. [27- 28]

Linearity: Linearity is the ability is considered to be analytical procedure to obtain a response that is directly proportional to the concentration (amount).in the validation process of the Linearity is usually expressed as the confidence limit around the slope of the regression line. [29]

Limits of detection and quantitation: The limit of detection (LOD) is defined as the lowest concentration of an analyte in a sample that can be detected, cannot be quantified by the analytical method of the detection. LOD (limit of detection) is expressed as a concentration at a specified signal: noise ratio, usually three: one. For LOQ (limit of detection), ICH (international council for Harmonization) has recommended a signal: noise ratio ten: one. The calculation based on the standard deviation LOD and LOQ of the response and the slope of the calibration curve at levels approximates the LOD according to the given below formulae. [30]
LOD = 3.3 × Slope /Standard Deviation and
LOQ = 10 × Slope /Standard Deviation

Specificity: Specificity is the ability of the analyte in this method the presence of components that may be expected to be present in the analytical method. Typically include impurities, degradants, matrix, etc. Measuring the analytical method is Lack of specificity of an individual analytical procedure by other supporting analytical procedure. This definition has Identification of the component: to ensure the identity of an analyte. Purity Tests: to perform ensure that all the analytical method (RP-HPLC method) procedures allow an very accurate in the statement of the content of impurities of an analyte, i.e. related substances test, heavy metals, residual other impurities. Solvents content, etc. the analytical method of Assay (content or potency): to provide an exact result that allows an accurate statement on the content or potency of the analyte in a sample. [31]

Range: The range of the method is the interval between the upper and lower levels of an analyte that has been determined with acceptable precision, accuracy, and linearity. It is determined a linear or nonlinear response curve and is normally expressed in the same units as the test results. [32]

Robustness: The robustness is an easily measure of its analytical procedure is the capacity to remain unaffected by small, but variations in method validation parameters and provides an indication of its reliability during normal usage. [33]

CONCLUSION

This review describes the RP-HPLC Technique. In the Chromatography (RP-HPLC) method development and validation are continuous and interrelated processes that measure a parameter as intended and establish the performance limits of the measurement is acceptable method. In the analytical RP-HPLC method used to selection of

Column, buffer, detector and wavelength and another condition composition (organic and pH) plays a dramatic role in the separation selectivity The advantages of HPLC technique were high selectivity, high sensitivity, low economic, less time consuming and low limit of detection. Final optimization can be performed by gradient slope, temperature, and flow rate as well as the type and concentration of mobile-phase modifiers. The optimized method is validated with parameters (e.g. the validated parameters is countable of the easy parameters1. specificity, 2. precision, 3.accuracy, 4. detection of limit and linearity, etc.) as per ICH guidelines.

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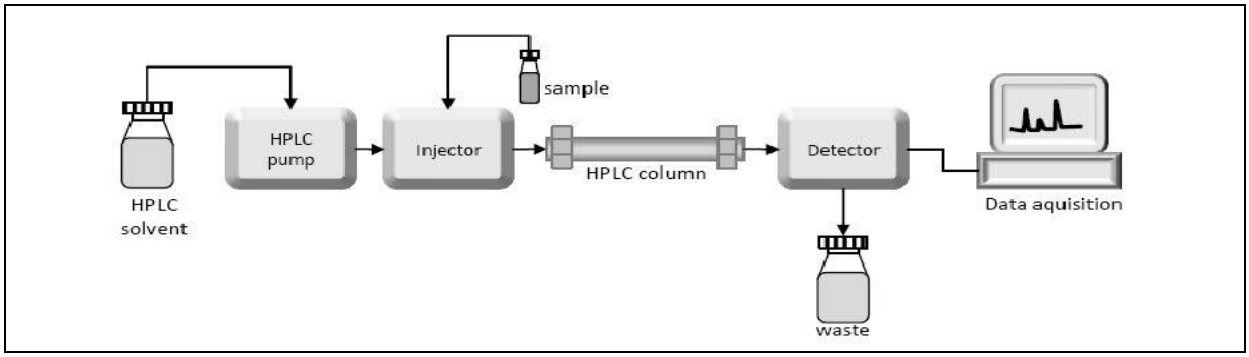
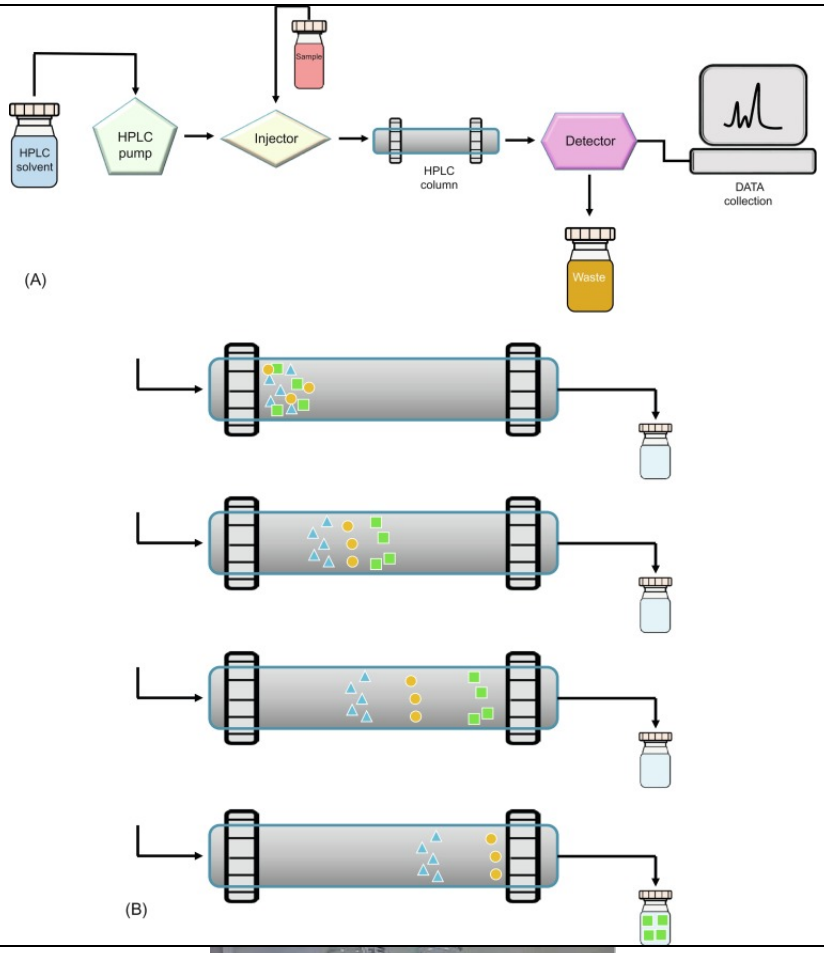
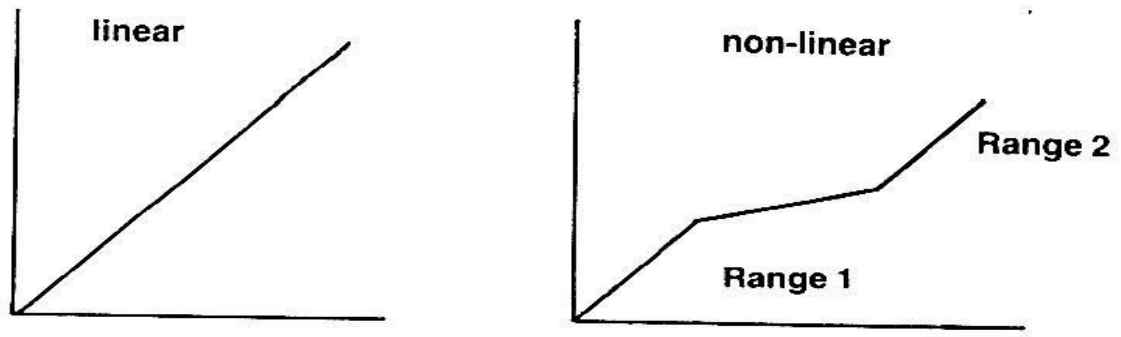
Mode	Solvent type used	Type of compound used
Reversed Phase	Water/Buffer, ACN, Methanol	Neutral or non-ionized compounds which can be dissolved in water/ organic mixtures.
Ion-pair	Water/Buffer, ACN, Methanol	Ionic or Ionizable compounds
Normal Phase	Organic solvents	Mixtures of isomers and compounds not soluble in Organic/ Water mixtures.
Ion exchange	Water/Buffer	Inorganic ions, proteins, nucleic acids, organic acids.
Size exclusion	Water, Tetrahydrofuran, chloroform	High molecular weight compounds.





Instrumentation of HPLC



Range

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RESEARCH ARTICLE

Behavior of Electric Pressure with Temperature for <100>+<111> Tunnelling Model with Electric Field along<110> Direction

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ABSTRACT

In the present paper we have investigated theoretically the variation of electrical pressure with temperature and electric field for <100>+<111> tunnelling model by applying the electric field along <110> direction only. In which electrical pressure increases with increases of temperature at constant electric field 10^6 V/m. Which may be used to explain various experimentally available data and may be also used for further theoretical investigations.

Keywords: Dielectric constant, tunneling model & Electrical Pressure.

INTRODUCTION

Diatomic and off-cantered monoatomic impurities alter the properties of host crystal drastically. There has been considerable recent interest in the impurity modes of ions substituted at lattice sites in alkali halide crystals. A small concentration of impurity doped in certain alkali halides cause a large rise in dielectric constant at low temperature[1].The octahedral potential for the angular motion of the diatomic impurity in solid state matrices was first presented by Devonshire[2].Many experimental results for system such as OH^- and CN^- ions in alkali halide matrices[3,4] and HCl,HBr etc impurities in rare gas matrices[5] have successfully explained. The effects of externally applied electric field on induced dipole moment of the impurity were studied by Gomez et al [6] using tunnelling models.

Theory-the electric field polarisation for the <110> off cantered model and for the model of simultaneous minima along the direction <110>+<111> has been explained by Pandey et al [7,8].Theoretical study of polarisation and

dielectric constant for the various tunnelling models has been given by Raj Kumar et al[9,10,11,12].In this paper we have to find out the expression for electric pressure for the<100>+<111>tunnelling model.

The expression of dielectric constant is given by

$$\varepsilon = \frac{dP}{d\varepsilon} \quad \text{.....1}$$

The expression of electric pressure is given by relation

$$S = \frac{\sigma^2}{2\varepsilon} \quad \text{..... 2}$$

Where σ is surface charge density.

The expression of polarisation for<100>+<111> tunnelling model is

$$P = N\frac{\left|\frac{\mu_1}{\sqrt{3}}\left(e^{x_1/\sqrt{3}}-e^{-x_1/\sqrt{3}}\right)+\sqrt{2}\frac{\mu_2}{2}\left(e^{x_2/\sqrt{2}}-e^{-x_2/\sqrt{2}}\right)\right|}{\left[3+e^{x_1/\sqrt{3}}+e^{-x_1/\sqrt{3}}+e^{2x_2/\sqrt{2}}+e^{-2x_2/\sqrt{2}}\right]} \quad \text{.....3}$$

Where $x_1 = \frac{\mu_1 E}{kT}$,$x_2 = \frac{\mu_2 E}{kT}$

Differentiating equation (3) with respect to electric field we get dielectric constant

$$\varepsilon = \frac{N}{kT}\left\{\left[\left(2\mu_1^2+\frac{8\mu_2^2}{3\sqrt{3}}\right)+\frac{3\mu_1^2}{2}\left(e^{x_1/\sqrt{2}}+e^{-x_1/\sqrt{2}}\right)+\frac{2\mu_2^2}{\sqrt{3}}\left(e^{2x_2/\sqrt{6}}+e^{-2x_2/\sqrt{6}}\right)\right.\right.$$
$$+\left(\frac{\mu_1^2}{2}+\frac{2\mu_2^2}{3\sqrt{3}}\right)\left(e^{x_1/\sqrt{2}}+e^{-x_1/\sqrt{2}}\right)\left(e^{2x_2/\sqrt{6}}+e^{-2x_2/\sqrt{6}}\right)$$
$$\left.\left.-\left(\frac{3+\sqrt{3}}{3\sqrt{3}}\right)\mu_1\mu_2\left(e^{x_1/\sqrt{2}}-e^{-x_1/\sqrt{2}}\right)\left(e^{2x_2/\sqrt{6}}-e^{-2x_2/\sqrt{6}}\right)\right]\right.$$
$$\left./\left[3+e^{x_1/\sqrt{2}}+e^{-x_1/\sqrt{2}}+e^{2x_2/\sqrt{6}}+e^{-2x_2/\sqrt{6}}\right]^2\right\}.$$

.....4

Using equation (4) &(2) we have electric pressure

$$S = \frac{\sigma^2 kT}{2N}\left\{\left[3+e^{x_1/\sqrt{2}}+e^{-x_1/\sqrt{2}}+e^{2x_2/\sqrt{6}}+e^{-2x_2/\sqrt{6}}\right]^2\right.$$
$$/\left[\left(2\mu_1^2+\frac{8\mu_2^2}{3\sqrt{3}}\right)+\frac{3\mu_1^2}{2}\left(e^{x_1/\sqrt{2}}+e^{-x_1/\sqrt{2}}\right)+\frac{2\mu_2^2}{\sqrt{3}}\left(e^{2x_2/\sqrt{6}}+e^{-2x_2/\sqrt{6}}\right)\right.$$
$$+\left(\frac{\mu_1^2}{2}+\frac{2\mu_2^2}{3\sqrt{3}}\right)\left(e^{x_1/\sqrt{2}}+e^{-x_1/\sqrt{2}}\right)\left(e^{2x_2/\sqrt{6}}+e^{-2x_2/\sqrt{6}}\right)$$
$$\left.\left.-\left(\frac{3+\sqrt{3}}{3\sqrt{3}}\right)\mu_1\mu_2\left(e^{x_1/\sqrt{2}}-e^{-x_1/\sqrt{2}}\right)\left(e^{2x_2/\sqrt{6}}-e^{-2x_2/\sqrt{6}}\right)\right]\right\}$$

..... 5

The variation of electric pressure with temperature at steady electric field is given in fig. 1 and the variation of electric pressure with electric field at constant T=10K is given in fig.2.

RESULT AND DISCUSSION

The result of present theoretical investigated for the <100>+<111> tunnelling model is given by equation 5. Fig.1 and Fig.2 shows the variation of electric pressure with temperature and electric field for<100>+<111> tunnelling model respectively. From Fig.1 it is seen that the electrical pressure increases with increases of temperature at constant electric field 10^6 V/m. From Fig.2 it is seen that electrical pressure increases slowly with increases electric field but afterward $30x10^6$V/m electrical pressure suddenly increases with increases electrical field for system<100>+<111>.This theoretical study will be useful in future theoretical as well as experimental investigations.

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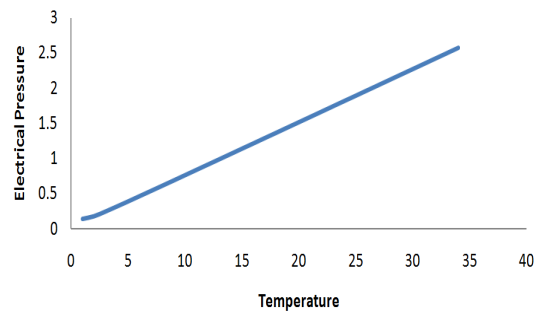

Fig.1. The variation of electric pressure with temperature

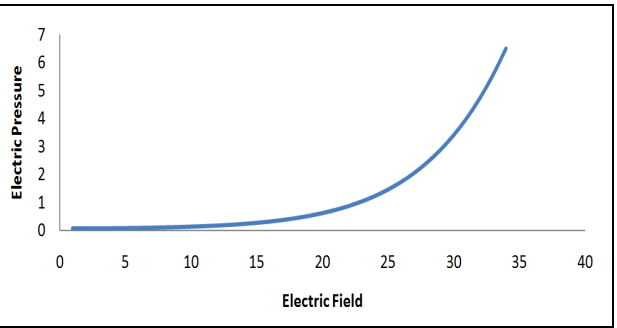

Fig.2. The variation of electric pressure with electric field

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REVIEW ARTICLE

A Review on Ultra Performance Liquid Chromatography

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ABSTRACT

UPLC can be regarded as improved for liquid chromatography. UPLC refers to Ultra Performance Liquid Chromatography. It brings sensitivity and speed of analysis. This instrumentation has to be operated at higher pressure as compared to High performance liquid chromatography. This review includes the theories & principle of Chromatography along with the Comparison between High performance liquid chromatography (HPLC) & Ultra Performance Liquid Chromatography (UPLC) and advanced feature are listed here in this review. Some of the most recent applications of UPLC are also included in this present paper.

Keywords: UPLC; HPLC; Chromatography; Sensitivity, Principle

INTRODUCTION

Chromatography is separating a mixture of components into individual components with the help of a porous medium under the influence of solvents. Before 2004, High-performance liquid chromatography was the most frequently useful technique for separating a mixture of components into individual components. But due to some limitations, a new technique has been introduced by the scientist who is highly efficient and advanced and has also overcome some of the limitations of HPLC and the new technique Ultra Performance Liquid Chromatography [1-5].UPLC is regarded as a new invention for liquid chromatography techniques. It brings sensitivity, resolution, and speed of analysis can be calculated. This instrumentation can perform at higher pressure as compared to that used in

High-performance liquid chromatography & this system uses fine particles (less than 2.5 µm) and mobile phases at maximum linear velocities to reduce the length of the column also reduces solvent consumption and saves time. This review introduces the working principle of Ultra Performance Liquid Chromatography along with some of the most recent work in the field. According to the van Deemter equation, as the size of particles reduces to below 2.5µm, there is significant gain inefficiency. Therefore, by using smaller than particles, speed and peak capacity can be extended to new limits, of liquid chromatography [6-10].

Brief History

Chromatography is a new technique that was first invented by Tswett, a Russian Botanist in 1906 in Warsaw used for the analysis of products. He successfully done the separation of chlorophyll, xanthophylls, and several others colored substances by percolating vegetable extracts with the help of a column of calcium carbonate. The column of calcium carbonate acts as an adsorbent and the different substances get adsorbed to a different extent and this gives rise to colored bands at a different position. [11-17].The column of calcium carbonate used in the Tsweet method analyzed remains stationary and is therefore termed as the stationary phase in this chromatographic technique. The solution of vegetable extracts moves or flows down the column and is therefore named the mobile phase in this chromatographic technique. Chromatography may be regarded as an analytical technique of separation of solutes that occurs between a stationary phase and a mobile phase [18-25]. In 1930 chromatography in the form of thin-layer chromatography (TLC) along with ion-exchange chromatography was introduced as a separation technique in this analytical process. In 1941, Martin and Synge introduced the technique as paper chromatography, and later gas chromatography in 1952 was used for the analysis of products. This analytical technique is used as a method for the preparation of very pure compounds in the fields like Pharmaceutical Industry and the Manufacture of pure chemicals. The recent spectacular developments in the field of bioscience are entire because of the chromatographic techniques of separation of bio-molecules. Later on, analytical techniques like High-performance liquid chromatography were introduced which have been used in many laboratories for a long period of time then after a new technique has been introduced recently called UPLC (Ultra performance liquid chromatography).

Principle

The chromatographic principle is based on adsorption or partition. In the analytical techniques, they can be called adsorption chromatography or partition chromatography.

Adsorption Chromatography: When adsorbate and mixture compounds are dissolved in the mobile phase (eluent) travels through a column of stationary phase (adsorbent), they move according to the relative affinities towards the stationary phase in the techniques. The analytical compound which has more affinity for the stationary phase travels slower and that having a low affinity towards the stationary phase travels faster. Hence the compounds are separated. No two compounds have the same affinity for a combination of stationary phase, mobile phase, and other analytical conditions.

Partition Chromatography: The most widely used type of Ultra performance liquid chromatography (UPLC) is partition chromatography. In the past, most of the applications have been to a non-ionic and polar compound of low moderate molecular mass (usually <3000.) The early forms of Partition chromatography liquid-liquid columns. These have been replaced in modern LC systems by liquid–bonded phase columns. In liquid-liquid chromatography, the liquid was held in place by physical adsorption. In bonded–phase chromatography, on the other hand, it's attached by Chemical Bonding, resulting in highly stable pickings insoluble in the mobile phase. Bonded Phase columns were also compatible with gradient elution techniques. Therefore, our discussion focuses exclusively on bonded–phase partition Chromatography [26-35].

Instrumentation

The various instruments used in the Ultra performance liquid chromatography are as follows (FIG. 1).

- Sample injection

- UPLC columns
- Column manger & heater or cooler
- Detectors
- Software's [36-41].

Advantages

- It decreases the run time and increases sensitivity in UPLC.
- Provides the sensitivity, selectivity, and dynamic range of LC analysis.
- Maintains the resolution performance.
- Expands scope of Multiresidue Methods.
- Faster analysis is possible with the use of a novel separation material that is of very fine particle size [42-44].
- The cost of operation in less.
- Solvent consumption is less.
- It decreases process cycle times, which helps to produce more products with limited resources too.
- Increasessamplethroughputandhelpsthemanufacturerstoproducemorematerialthatconsistentlymeetsandexcee dsthe product specifications, also potentially eliminates variability, failed batches, or the need to re-work material [45-53].

Disadvantages

- Due to increased pressure, frequent maintenance is required and reduces the life of the columns of thistype.
- In addition, the phases below 2 μm are generally non-regenerable and thus have limited use[54-58].

Applications

Analysis of natural products and traditional herbal medicine

This technique is popularly used for the separation of natural products and traditional herbal medicine. It has highly advanced detection and separation capabilities to identify active compounds that are present in the samples of natural products and herbal medicines.

Study of metabonomics

Metabonomics studies are carried out in Micro labs to accelerate the development of new medicines. It provides a quick and robust method for detecting the changes, improves understanding of potential toxicity, and allows observing the capacity. The correct application of metabolomics information helps in the discovery, development, and manufacturing processes in the biotechnology and chemical industry companies.

Identification of metabolite

Biotransformation of new chemical entities (NCE) is necessary for drug discovery in the metabolite process. Ultra-performance liquid chromatography (UPLC) addresses the complex analytical requirements of new discovery by providing unmatched resolution, sensitivity, and mass accuracy in this analytical process [59-63].

ADME (Absorption, Distribution, Metabolism, Excretion) Screening

Pharmacokinetics studies include studies of ADME. It studies important physical and biochemical properties like absorption, distribution, metabolism, elimination, etc. where such compounds show its activity against the target disease.

Manufacturing / QA / QC

Identification of purity, quality, safety, and efficacy are the most important analytical methods that need to be considered while manufacturing a drug product. For the successful analytical production of quality pharmaceutical products, the raw materials need to meet the purity speciation. These can be achieved with the help of the Ultra performance liquid chromatography technique [64-68].

Impurity Profiling

These techniques easily detect the impurities present if it is presented in very trace levels too. UPLC combines with the same mass LC/MS, which by running with different low and high collision energies, has been successfully used for the detection of drug and endogenous metabolites.

UPLC fingerprint

It can be used for the identification of the Magnolia Officinalis cortex [69-75].

Dissolution Testing

Dissolution testing is one of the most important steps carried out during formulation and manufacturing process to test the drug release. The dissolution profile is used to demonstrate the reliability and batch-to-batch uniformity of the active ingredient.

Method development/Validation

UPLC help in critical laboratory function by increasing efficiency, reducing costs, and improving opportunities for business success. UPLC column chemistries can easily translate across analytical- and preparative-scale separation tasks. UPLC provide efficiencies in method development: Using UPLC, analysis times becomes as short as one minute, methods can be optimized in just one or two hours.

Analysis of amino acid

UPLC used for accurate, reliable and reproducible analysis of amino acids in the areas of protein characterizations, cell culture monitoring and nutritional analysis of foods.

Determination of pesticides

UPLC couples with triple Quadra tandem mass spectroscopy will help in identification of trace level of pesticides from water. [81].

CONCLUSION

UPLC increases and expands the significance of chromatography. The main asset is a decrease in analysis time, which also reduces the consumption of solvent which plays a vital role in an analytical laboratory. It gives sharp and narrow peaks to all categories of pharmaceutical drugs. It also facilitates the analysis of complex mixtures in a relatively short time and the peak obtained with the help of these method provides more information which is more convenient and clear that of HPLC. This technology thus creates a new opportunity for business profitability in a highly efficient manner and helps the product to be introduced within a short period of time. Overall, it seems that UPLC can offer significant improvements in speed, resolution, and sensitivity compared with the conventional HPLC techniques [76-80].

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RESEARCH ARTICLE

Evaluation of Growth and Photosynthetic Pigments of *Setaria italica* (Foxtail Millet) under Drought Stress

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ABSTRACT

Foxtail millet (*Setaria italica* L.) one of the predominant minor millet, which can be used as an alternative for cereal-based utilization with a great value of proteins and β-carotene. Drought is a major environmental stress, which reduces crop yield and influences ecosystems worldwide. Drought affects all the stages of plant growth including seed germination, growth, photosynthesis and crop yield, resulting in huge economic losses. The present study was aimed to assess the changes in growth and photosynthetic pigments under drought stress. The pots were filled with a homogenous mixture of garden soil containing red soil, sand along with farmyard manure in the ratio of 1:1:1. The pots were arranged in Completely Randomized Block Design (CRBD). The drought stress given on 2, 4, 6 and 8 DID (Days Interval Drought), then one-day interval irrigation on groundwater was kept as control. The plant samples were collected on 30, 45, 60 and 75 DAS. The results showed the root length was increased and shoot length and pigments reduced in all treatments when compared to control at increasing plant maturity.

Keywords: Drought, Foxtail millet, *Setaria italica*, Photosynthetic pigments and Day Interval Drought.

INTRODUCTION

Growth and the productivity of agricultural crops are negatively affected by various abiotic and biotic stress factors in worldwide (Mahajan and Tuteja, 2005). In crop plants, several physiological and biochemical pathways are

bothered during abiotic stress conditions (Bandyopadhyay *et al.,* 2018). In worldwide, around 40% of the total production of all categories of food grains is mainly affected by water deficit [3].Agricultural productivity in most of the arid and semi-arid regions of the world is severely impacted by drought [4]. Drought is a major environmental stress, which reduces crop yield and influences ecosystems worldwide [5]. Drought affects all the stages of plant growth including seed germination and crop yield, resulting in huge economic losses [6]. Drought is one of the main factors affecting growth, cell expansion, stomatal conductance, biomass, and crop production [7].Drought stress combines with global climate change progressively causes severe destruction in agriculture and also threatening food security worldwide [8].

Drought stress-induced in various morphological and physio-chemical changes in plants like the reduction of photosynthesis rate and transpiration level, a decrease of stomatal activity, pigment concentration, and relative water content [9]. Drought stress can decrease the yield of grain, have approximated the average yield loss of up to 17 to 70% in grain yield due to drought [10].During drought stress, photosynthesis was interrupted, which results in the closing of stomata and decrease of CO_2 levels in leaf [11]. Plants under drought conditions decrease overall photosynthetic rate and transpiration, when photosynthesis is reduced and light excitation energy is in excess of that used in photosynthesis, over-excitation of the photosynthetic pigments in the antenna can occur, leading to the accumulation of reactive oxygen species (ROS) in chloroplasts [12].Drought stress leads to changes in the content of Chlorophyll pigments and carotenoids[13]. Drought stress, by controlling stomatal conductance to reduce photosynthesis, enormous light energy that cannot be converted to chemical energy and breaks cellular physiological homeostasis [14] during production of reactive oxygen species (ROS) in chloroplasts and mitochondria [12]. In addition it inhibits the photochemical activities and decrease the activities of enzymes in the Calvin cycle in photosynthesis [15].

Millets are a predominant food that supplies a maximum level of calories and proteins to the populations in the arid and semi-arid tropical countries of Africa and Asia [16]. Minor millets also have a good protein and a better amino acid profile [17]. Foxtail millet one of the important minor millet, which can be used as an alternative for cereal-based utilization with a great value of proteins and β-carotene [18]. Foxtail millet (*Setaria italica* (L.) Beauv) is a C4 graminaceous plant that belongs to the family Poaceae and, which originates from China, is extensively cultivated in northern China and in other Asian countries [19]. In arid and semi-arid regions, Foxtail millet is a vital food and fodder grain crop and also a potential biofuel plant [20, 21]. The main aim of this study to evaluate the changes of growth, biomass and photosynthetic pigments under drought stress.

MATERIALS AND METHODS

Seed collection and Experimental work

The healthy seeds of *Setaria italica* were collected from tribal people of Kolli hills, Western Ghats India. The experimental part of this work were carried out in Botanical Garden and Stress Physiology Lab, Department of Botany, Annamalai University, Tamil Nadu, India. The plants were raised in plastic pots of 30 cm diameter and 40 cm height size were used for the study. The pots were filled with homogenous mixture of garden soil containing red soil, sand along with farmyard manure in the ratio of 1:1:1. The pots were arranged in Completely Randomized Block Design (CRBD). The experimental seeds were surface sterilized with 0.2% Mercuric chloride solution for five minutes with frequent shaking and thoroughly washed with tap water. The plants were allowed to grow up to 30 days with regular water irrigation. After 30days, well established plants were selected for treatments. The drought stress given on 2 DID (Days Interval Drought), 4 DID, 6 DID and 8 DID then one day interval irrigation on ground water was kept as control. The plant samples were collected on 30, 45, 60 and 75 DAS.

Growth and biomass analysis

The length between shoot tip and the point of the root shoot transition region was taken as shoot length. Root length was recorded by measuring below the point of root-shoot transition to the fibrous roots and the lateral roots was taken as total root length. The shoot and root length are expressed in centimeters per plant^{-1}. Fresh and dry weight was measured by using an electronic balance (Citizen Scales PVT LTD., Model XK3190-A7M). In additionally the plants were dried at 60ºC in hot air oven for 24 hours. After drying, the weight was measured and both of values are expressed in grams per plant^{-1}.

Photosynthetic Pigments

Chlorophylls and Carotenoids

Chlorophyll content were estimated according to Arnon (1949) [22] method. One gram of fresh leaves were extracted with 80% Acetone (v/v) and chlorophyll content were estimated spectrophotometrically at 645 and 663 nm using Hitachi U-2000 spectrophotometer. Chlorophyll content was calculated using the followed formula and were expressed in terms of mg chlorophyll present per gram fresh mass.

Chlorophyll 'a' (mg/ml) = (0.0127) X (A. 663) – (0.00269) X (A. 645)

Chlorophyll 'b' (mg/ml) = (0.0229) X (A. 645) – (0.00468) X (A.663)

Total Chlorophyll (mg/ml) = (0.0202) X (A. 645) + (0.00802) X (A. 663)

Carotenoid

Carotenoid content was estimated using the method of Kirk and Allen (1965) [23] and expressed in milligrams per gram fresh weight.

Carotenoid = A. 480 + (0.114 X A. 663 – 0.638 X A. 645)

Xanthophyll and Anthocyanin

Xanthophyll contents were estimated by the method of Davies (1965) [24] with a little modification of Neogy*et al.,* (2001) [25]. Anthocyanin content was extracted and estimated by the method of Zhang and Quantick (1997) [26].

RESULTS AND DISCUSSION

Effect of drought on growth

The present investigation, drought stress may increase root length but reduce shoot length (Table. 1). The root length increased by drought stress treatment compared to control for all growth stages of *S.italica*. The highest increase in root length was found to be 110.06, 118.86, 127.04 and 141.50 per cent over control and shoot length was recorded to be 95.73, 91.8, 85.91 and 72.99 percent over control in 2, 4, 6 and 8 DID stressed plants respectively at 75 DAS. Plant root system have evolved various defence mechanisms against drought stress at morpho-physiological and molecular levels, such as root architecture adaptation, osmotic adjustment, enhancement of the antioxidant defence system, maintenance of cell membrane stability, and expression of drought responsive genes and proteins [27, 28]. The similar results were observed in *Triticum aestivum*[29],*Cicer arietinum* [30],*Vigna mungo* [31], *Sorghum* [32], *Lycopersicon esculentum* [33], *Eleusine coracana* [34], *Zea mays* [35]and *S. viridis*[36].

Fresh and Dry weight of whole Plant

There was a reduction of fresh weight of *S. italica*, due to drought stress (Table.2). The highest reduction of fresh weight was recorded to be 89.19, 76.69, 68.56 and 58.23 per cent over control and dry weight was recorded to be 94.08, 88.48, 75.80 and 67.36 per cent over control at 75 DAS in 2, 4, 6 and 8 DID stressed plants respectively. Drought causes aggressive effects on plant growth (biomass production), [37]. This demonstrate the plants reduce their growth as an adaptation response to stress rather than as a secondary consequence of resource limitations [38] and finding are similar in *Eleusine coracana* [34], *Triticum aestivum* [39],*Cicer arietinum*[30] and *Arachis hypogaea* [40].

Photosynthetic Pigments

The results showed that the photosynthetic pigment of chlorophyll was decreased by increasing drought stress. The chlorophyll was declined from well watering control plant to severe drought stress at 8 DID and pigment was increased by the age of maturity in plant. The reduction of chlorophyll-a content (Graph. 1) was found to be 94.27, 88.16, 71.56 and 33.39 percent over control then 73.42, 91.44, 55.63 and 27.47 per cent over control of chlorophyll-b (Graph. 2) at 75 DAS of 2, 4, 6 and 8 DID respectively. A significant decrease with increasing drought stress treatments was observed in total chlorophyll (Graph. 3) on 75 DAS and the values are recorded to be 84.81, 89.66, 64.24 and 30.68 percent over control at 2, 4, 6 DID stressed plants respectively. Water deficit changes water status and chlorophyll content and the chl-a, chl-b and total chlorophyll content of the drought treated *S. italica* plant as decreased when compared to control plant. The similar report is observed in *Glycine max* [41], *Cicer arietinum*[42], *Eleusine coracana* [34], *Brssica napus* [43], *Allium cepa* [5], *Prunus persica* [44] and *Arachis hypogaea* [45].

The drought stress caused reduction of carotenoid content (Graph. 4) and it was 95.19, 86.53, 81.73 and 77.40 per cent over control on 75 DAS at 2, 4, 6 and 8 DID stress respectively. The maintenance of higher levels of carotenoids in comparison to chlorophylls due to drought indicate their important role in ROS scavenging system [46]. Reduced carotenoid content under drought was reported in *Zea mays*[47], *Glycine max*[48] and *Pisum sativum* [49]. Xanthophyll content increased with age of plant. The xanthophyll content (Graph. 5) was decreased by drought stress in all the sampling days. It was recorded to be 96.05, 80.30, 79.57 and 78.54 per cent over control on 75 DAS at 2, 4, 6 and 8 DID stress respectively. Similar results were observed in *L.esculentum* [50], *Triticum aestivum* [51], *Hordeum vulgare*[52], *Zea maize* [53]. The anthocyan in content (Graph. 6) was decreased by drought stress treatment in *S. italica*. It was recorded to be 96.05, 80.30, 79.57 and 78.54 percent over control on 75 DAS at 2, 4, 6 and 8 DID stress respectively. Similar results were observed in *L.esculentum* [50], *Hordeum vulgare* [52] and *Triticum aestivum*[51].

CONCLUSION

The present investigation, concludes with increase root length, decrease shoot length and biomass, reduction in pigments occur in *S. italica*. It may prevent the oxidative cell death due to the drought stress and mechanism of alternative way to prevent cell damage of cell.

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Table 1. Drought stress induced changes in root and shoot length of *S.italica*(values are the mean of 7 replicates and expressed in cm plant-1)

Treatments	Root length			
	30 DAS	45 DAS	60 DAS	75 DAS
Control	10.42±0.12	12.51±0.02	13.83±0.14	15.94±0.42
2 DID	11.25±0.22	13.82±0.14	15.36±0.03	17.52±0.14
4 DID	12.53±0.12	15.57±0.08	17.46±0.35	18.91±0.29
6 DID	14.34±0.09	16.82±0.12	18.76±0.18	20.25±0.13
8 DID	16.74±0.16	18.62±0.24	20.44±0.22	22.52±0.17
	Shoot length			
Control	37.41±0.15	51.63±0.18	74.21±0.09	93.74±0.26
2 DID	35.53±0.27	49.88±0.22	72.61±0.04	89.75±0.12
4 DID	32.41±0.15	45.22±0.21	68.81±0.53	86.19±0.26
6 DID	28.68±0.19	40.34±0.21	62.71±0.36	80.59±0.12
8 DID	22.52±0.07	34.27±0.27	57.81±0.16	68.49±0.33

Table 2.Drought stress induced changes in fresh and dry weight of *S.italica* (values are the mean of 7 replicates and expressed in gm plant-1)

Treatments	Fresh Weight for whole Plant			
	30 DAS	45 DAS	60 DAS	75 DAS
Control	8.04±0.23	10.22±0.32	17.14±0.10	25.45±0.48
2 DID	6.04±0.53	8.32±0.35	12.43±0.45	22.70±0.55
4 DID	4.51±0.25	6.62±0.28	9.66±0.28	19.52±0.33
6 DID	2.28±0.18	4.32±0.25	7.13±0.45	17.46±0.28
8 DID	0.96±0.04	1.99±0.13	4. 69±0.19	14.82±0.20
	Dry Weight of Whole Plant			
Control	1.83±0.06	2.18±0.08	4.35±0.08	6.25±0.06
2 DID	1.54±0.04	1.88±0.05	3.80±0.30	5.88±0.34
4 DID	1.28±0.08	1.65±0.08	3.56±0.16	5.53±0.16
6 DID	1.02±0.04	1.43±0.06	2.91±0.05	4.73±0.19
8 DID	0.54±0.14	1.05±0.03	2.61±0.11	4.23±0.12

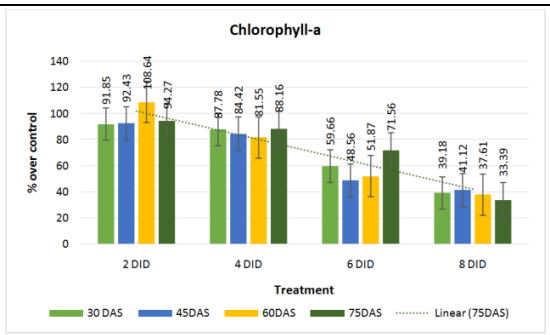

Figure 1: Drought stress induced changes in chlorophyll 'a' content of the *S.italica*(Values are expressed in percent over control)

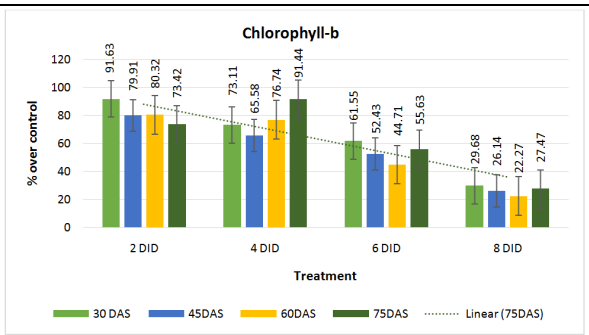

Figure 2: Drought stress induced changes in chlorophyll 'b' content of the *S.italica* (Values are expressed in percent over control)

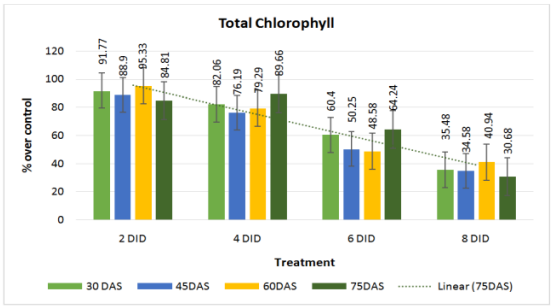

Figure 3: Drought stress induced changes in total chlorophyll content of the *S. italica* (Values are expressed in percent over control)

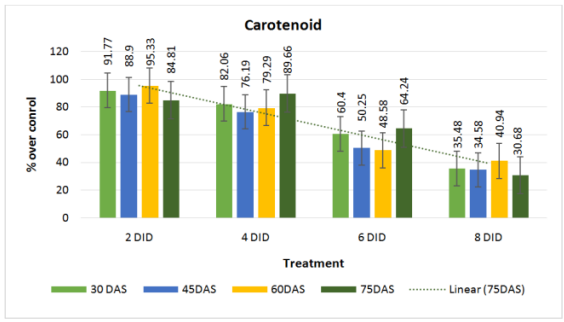

Figure 4: Drought stress induced changes in carotenoid content of the *S.italica* (Values are expressed in percent over control)

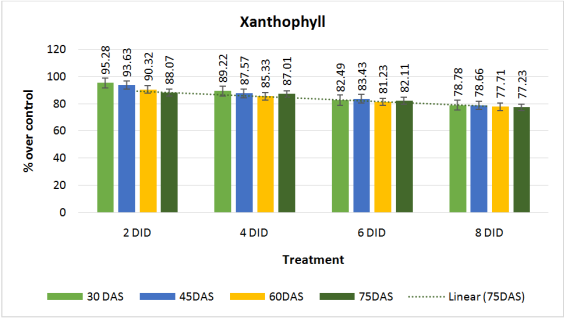

Figure5: Drought stress induced changes in xanthophyll content of the *S.italica* (Values are expressed in percent over control)

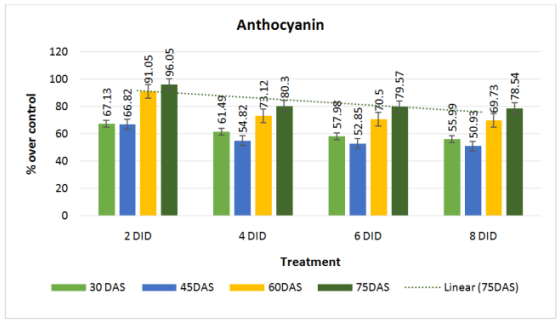

Figure 6 : Drought stress induced changes in Anthocyanin content of the *S.italica* (Values are expressed in percent over control)

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RESEARCH ARTICLE

Pharmacognostical Evaluation of *Hygrophila auriculata* (Schum.) Heine

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ABSTRACT

Cancer treatments that are currently available have variable degrees of efficacy in reducing cancer symptoms. Chemotherapeutic medications, on the other hand, frequently induce adverse effects in patients, worsening the morbidity and mortality in patients with cancer. The huge repertory of plant-derived phytoconstituents found in nature is being used to generate new and improved anti-cancer medications all around the world. This research aims atanalyzing the potential of the angiosperm plant *Hygrophila auriculata* (Schum.) Heine (which has demonstrated some anticancer benefits) as a potential source ofanti-tumor medicines. The study of phytochemicals in plants has great significance in understanding their various medicinal properties. Flavonoids, alkaloids, terpenoids, saponins, tannins, steroids, quinones, proteins, cardiac glycosides of the whole plant extract of selected medicinal plant, *Hygrophila auriculata* was performed. The plant was collected from Chengalpattu, Tamil Nadu, India. Different solvents of increasing polarity were used as solvent for sequential extraction. Flavanoids and terpenoids were present in abundant amounts whereas other phytochemicals, namely, steroids and cardio glycosides were present in moderate amounts.The anti-oxidant activity was determined by DPPH scavenging methods. As this plant species is known to contain a variety of bioactive components, many of which are yet unknown, it is assumed that some of these phyto-constituents may have lethal effects unique to tumour cells and hence might be exploited to generate new anti-neoplastic medications.This knowledge could be of great value for ascertaining the medicinal role of this plant.

Keywords: Phytochemicals, *Hygrophila auriculata*, flavonoids, terpenoids

INTRODUCTION

Medicinal plants have been used as traditional treatments for numerous human diseases for thousands of years and they are continued to be an important therapeutic aid for alleviating the ailments of humankind [1]. Therapeutic

benefits can be traced to specific plant compounds; many herbs contain dozens of active constituents that together combine to give the plant its therapeutic value [2]. A growing body of evidence indicates that secondary plant metabolites plays an important role in human health and may be nutritionally important [3]. Phytochemical screening of various plants has been reported by many workers [4]. These studies have revealed the presence of numerous chemicals including alkaloids, flavonoids, steroids, phenols, glycosides and saponins. The phenolic compounds are one of the largest and most ubiquitous groups of plant metabolites [5]. A number of studies have focused on the biological activities of phenolic compounds which are antioxidants and free radical scavengers [6].

Free radicals (superoxide, hydroxyl radicals and nitric oxide) and other reactive species (hydrogen peroxide, hypochloric acid and peroxynitrite) produced during aerobic metabolism in the body, can cause oxidative damage of amino acids, lipids, proteins and DNA [7]. It has been established that oxidative stress is one among the major causative factors in the induction of many chronic and degenerative diseases including atherosclerosis, ischemic heart disease, ageing, diabetes mellitus, cancer, immune suppression, neurodegenerative diseases and others [8]. The most effective way to eliminate free radicals which cause the oxidative stress is with the help of antioxidants. Antioxidants, either exogenous or endogenous, whether synthetic or natural, can be effective in preventing free radical formation by scavenging them or promoting their decomposition and suppressing such disorders [9]. In addition, phenolic compounds and flavonoids are also widely distributed in plants which have been reported to exert multiple biological effects, including antioxidant, free radical scavenging abilities, anti-inflammatory, anti-carcinogenic etc. [10]. The crude extracts of herbs, spices and other plant materials, rich in phenolics and flavonoids are of increasing interest in the food industry because they retard oxidative degradation of lipids and thereby improve the quality and nutritional value of food [11].

Hygrophila auriculata (L.), is a wild herb belonging to Acanthaceae family and has been advocated for the treatment of variety of diseases including most commonly diabetes and dysentery [12]. The plants are widely distributed throughout India, Sri Lanka, Burma, Malaysia and Nepal. Following various folk claims as a cure for numerous diseases and efforts have been made by researchers to verify the efficacy of the plant by scientific biological screening. The plant is a sub shrub, usually growing in marshy places along water courses reddish brown stem and the shoot has 8 leaves and six thorns at each node. The plant contains saponins, alkaloids, steroids, tannins, flavonoids and triterpenoids as the main phytoconstituents. The plant has been used in the treatment of jaundice, hepatic obstruction, rheumatism, inflammation, urinary infection, gout, malaria and revealed some notable pharmacological effects like antitumor, free radical scavenging, anthelmintic, antipyretic and antimotility activities [13]. The role of the plant on paracetamol and thioacetamide intoxication in animals was also studied [14]. A related plant *H. spinosa* was also studied for its antibacterial, anti-inflammatory and antipyretic role by Patra *et al*, 2009 [15]. Eazhisavallabhi *et al*, 2012, has reported preliminary phytochemical analysis and antibacterial role of *H. spinosa* [16]. The aim of the present work is to carry out the qualitative phytochemical screening from leaf and stem extracts of *Hygrophila auriculata*.

MATERIALS AND METHODS

Collection of Samples

The medicinal plants used for the experiment were collected as whole plants from the nearby areas of Aarupadai Veedu Institute of Technology, Paiyanoor, Chengalpattu (Dist.) in Tamil Nadu, India. The plant was identified, confirmed and authenticated by Prof.P.Jayaraman, National Institute of Herbal Science – Plant Anatomy Research Centre, Chennai. The voucher specimen was given the No. PARC/2021/4379. Different aerial parts of plant such as leaves, stem, spikes and flowers are separated and dried under shadow for 10 days. The pictures of the plant and separated plant materials were shown below in fig 1 and 2.

Preparation of Extracts

The dried plant materials were subjected to pulverization using mixer grinder to get coarse powder. About 35 gm of dried powder was weighed and packed in separate round bottom flask for Soxhlet extraction with 150ml of hexane. The extract was collected after filtration using Whatman No: 1 filter paper in a Buchner funnel and was stored at room temperature. Another 150ml of chloroform was added to the residual mixture and the extract was collected again using a Whatman No: 1 filter paper. This procedure was repeated once again with 150 ml of methanol (Fig. 3) and the extract was filtered. The extract was then concentrated in a vacuum rotary evaporator at 40° C as shown in Fig. 4 to a constant weight. The concentrated extracts were stored in airtight container and refrigerated below 10º C which was used for further phytochemical analysis, antimicrobial activity and anticancer activity.

Phytochemical Analysis

The extracts prepared were analyzed qualitatively for the presence of alkaloids, saponins, tannins, steroids, flavonoids, anthraquinones, cardiac glycosides and reducing sugars based on the standard protocols [16, 17, 18].

Test for carbohydrates

To 2ml of plant extract, 1ml of Molisch's reagent and few drops of concentrated sulphuric acid were added. Presence of purple or reddish color indicates the presence of carbohydrates.

Test for tannins

To 1ml of plant extract, 2ml of 5% ferric chloride was added. Formation of dark blue or greenish black indicates the presence of tannins.

Test for saponins

To 2ml of plant extract, 2ml of distilled water was added and shaken in a graduated cylinder for 15minutes lengthwise. Formation of 1cm layer of foam indicates the presence of saponins.

Test for flavonoids

To 2ml of plant extract, 1ml of 2N sodium hydroxide was added. Presence of yellow color indicates the presence of flavonoids.

Test for alkaloids

To 2ml of plant extract, 2ml of concentrated hydrochloric acid was added. Then few drops of Mayer's reagent were added. Presence of green color or white precipitate indicates the presence of alkaloids.

Test for quinones

To 1ml of extract, 1ml of concentrated sulphuric acid was added. Formation of red color indicates presence of quinones.

Test for cardiac glycosides

To 0.5ml of extract, 2ml of glacial acetic acid and few drops of 5% ferric chloride were added. This was under layered with 1 ml of concentrated sulphuric acid. Formation of brown ring at the interface indicates presence of cardiac glycosides.

Test for phenols

To 1ml of the extract, to this 1ml of 5% Ferric chloride was added. Formation of blue or green color indicates presence of phenols.

Test for Coumarins

To 1 ml of extract, 1ml of 10% NaOH was added. Formation of yellow color indicates presence of coumarins.

Test for Phlobatannins

To 1ml of plant extract few drops of 2% HCL was added appearance of red color precipitate indicates the presence of phlobatannins.

Test for Anthraquinones

To 1ml of plant extract few drops of 10% ammonia solution was added, appearance of pink color precipitate indicates the presence of anthraquinones.

Test for Test for glycosides

To 2ml of plant extract, 3ml of choloroform and 10% ammonia solution was added. Formation of pink color indicates the presence of glycosides.

Test for terpenoids

To 0.5ml of extract, 2ml of chloroform was added and concentrated sulphuric acid was added carefully. Formation of red brown color at the interface indicates the presence of terpenoids.

Test for Steroids and phytosteroids

To 1ml of plant extract equal volume of chloroform was added and subjected with few drops of concentrated sulphuric acid appearance of brown ring indicates the presence of steroids and appearance of bluish brown ring indicates the presence of phytosteroids.

Quantitative Phytochemical Analysis

Determination of Total Phenolic content

The amount of phenolic compounds in the extracts was determined by the Folinciocaletu calorimetric method and calculated from a calibration curve obtained with gallic acid as standard (10mg/10ml).From standard solution 0.1 to 0.5 ml was taken and added to different test tubes named as S1-S5. Extract was aliquoted in a separate test tube at a concentration of 100µl/ml and 5ml of folin's – ciocalteu (1:10dilution) was added and the content were mixed thoroughly. 4ml of 0.7 M Sodium carbonate was added and mixture was incubated for 30 minutes. The absorbance was measured at 765 nm in a UV-Visible spectrophotometer.

Determination of Flavonoids content

The flavonoid content was determined by aluminium chloride method using Quercetin as standard [19]. Extracts and Quercetin were prepared in Ethyl acetate (10 mg/ mL). 0.1 mL of extract was mixed with 0.9 mL of distilled water in test tubes, followed by addition of 75 µL of 5% sodium nitrate solution. After 6 minutes, 10 µL of 10% aluminium chloride solution was added and the mixture was allowed to stand for further 5 minutes after which 0.5 mL of 1M Sodium hydroxide was added to the reaction mixture. The reaction mixture was brought to 2.5 mL with distilled water and mixed well. The absorbance was measured immediately at 510 nm using a spectrophotometer. A calibration curve was generated using various concentrations of Quercetin and the Quercetin equivalence (QE) of the sample was expressed in µg/mg of the extract.

Antioxidant Activity

The ability of the sample to annihilate the DPPH radical (1,1-diphenil-2-picrylhydrazyl) was investigated by the method described in previous studies [20]. Stock solution of compound was prepared to the concentration of 10 mg/ml. Different concentration of the extract (20, 40, 60, 80 and 100 µg/mL) of sample were added, at an equal volume to methanolic solution of DPPH (0.1mM). The reaction mixture was incubated for 30min at room temperature; the absorbance was recorded at 517 nm. The experiment was repeated for three times. Ascorbic acid was used as standard control. The annihilation activity of free radicals was calculated in percentage inhibition according to the following formula

% of Inhibition = (A of control – A of Test)/A of control * 100

RESULTS AND DISCUSSION

The crude extract was obtained after extraction withdifferent organic solvent of increasing polarities such as hexane, chloroform and methanol. In the present study, the yield and the colour of the extracts from different solvents were identified and recorded (Table 2) and the presence of 14 phytochemicals were recorded in the Table 3 from the leaf extract of *Hygrophila auriculata*. This plant finds its place in the treatment of a wide range of ailments. Asolkar et al, 1992 have reported the alcoholic extract of this plant was spasmolytic and hypotensive [21].

Qualitative analysis

The various phytochemicals present in the extracts of plant, *Hygrophila auriculata* was indicated in Table 3.It was observed that flavanoids and terpenoids were present in abundance whereas tannins and quinones are also present. The presence of terpenoids show cytotoxic activity against a wide range of organisms ranging from bacteria and fungi. Flavanoids are probable to be responsible for free radical scavenging effects. The presence of flavanoids in large amounts indicates that *Hygrophila auriculata* owes it medicinal properties. These phytochemicals are the key candidates in the medicinal value of the plants. These datas can help us to choose the superior race of this valuable plant with greater quantity of medically and therapeutically important phytochemicals. Some more compounds are to be revealed to increase the efficiency of plant for using as anticancer agent. Burkil illustrated that the leaves of *Cleome rutidosperma* are used to cure ear inflamation, anthelminthic and carminative and they are rich in alkaloids (0.34%), tannins (15.25%), saponin (2%), flavonoid (3.04%) and cardic glycoside (0.2%) [22]. *Euphrobia reterophylla* leaves are used in the treatment of erysipelas, cough, bronchial paroxymal asthma, hay fever etc. [23] and the quantitative analysis study by Holm et al., recorded 0.86% of alkaloids, 0.1% of phenols, 12% of tannins, 0.74% of flavonoid, respectively [24]. Presence of quinine was observed clearly only with petroleum ether extract in all the parts of the plant and the red colour development was identified in the stem and flower parts with ethanol extract. Brown ring formation was observed in the leaf and flower parts of the plant indicating the presence of cardiac glycosides in the ethanol extract. Cardiac glycosides are efficient in the treatment of cardiac failure and also inhibits the sodium-potassium pump by stabilizing E2-P transition state [25]. There was no indication of brown ring formation in petroleum ether extract which indicated the absence of cardiac glycosides in all the parts of the plant.

Quantitative Analysis

The total phenol contents of crude extractswas determined by Folin-Ciocalteu method and reported asgallic acid equivalents. In our study, total flavonoid content of *Hygrophila auriculata* leaf extract was estimated by using aluminium chloride method and represented in terms of quercetin equivalent (QE). The highest phenolic content was absorbed in hexane extract of *HA*(302.2 µg gallic acid equivalence/mg) followed by chloroform extract and methanolextract of leaves. The total phenolic content in plant extract depends on the type of extract, i.e. the polarity of the solvent used in extraction. The phenols are known to possess antibacterial, antiviral, antimutagenic and anticarcinogenic properties [26].Based on the results of total phenol content in the leaves of *HA* it can be proposed that biological activity of this species could be due to the presence of phenolics in it.Flavonoids are regarded as one of the most widespread groups of natural constituents found in plants. The values of flavonoid content varied from plant to plant. It has been recognized that flavonoids show antioxidant activity and their effects on human nutrition and health are considerable. The mechanisms of action of flavonoids are through scavenging or chelating process. The result showed that the flavanoids content of *Hygrophila auriculata* methanolic leaf extract was found to be maximum as 157.98 µgQE/mg).The total flavonoids recorded during the present study ranged from 9.2 to 24.5 µg mg^{-1} in the leaf extract and from 7.3 to 30.4 µg mg^{-1} in the flower extract [27]. Farisha et al., also reported the presence of flavonoid in *Cinnamomum sulphuratum* and it ranged from 0.2 to 1 µg/ml of various parts of the plant extracts [28]. Milan estimated the total flavonoid content in *Marrubium peregrinum* leaf extract with five different solvents (methanol, water, ethyl acetate, acetone and petroleum ether) and found that the methanolic extract of the leaf registered 54.77 mg/ml, 51.33 mg/mlin ethyl acetate and 53.47 mg/ml in acetone extract, respectively [29].

Antioxidant activity

The leaves extract of *HA* were evaluated for their in vitro antioxidant activity using DPPH method. For DPPH, the maximum anti-oxidant effect was observed in higher concentration (100 µg/ml) of all tested samples. The highest scavenging activity was obtained from the methanolic extract of *HA* (95%) followed by chloroform extract (88%) and hexane extract (87%) and were compared with the standard, ascorbic acid. These results suggest that the extracts contain compounds that are capable of donating hydrogen to a free radical in order to remove odd electron which is responsible for radical's reactivity. Thus the bioactive compounds from *HA* have the ability to discolour DPPH solution by their hydrogen donating ability. The aboundance of flavonoids in fruits, vegetables are known to be highly effective antioxidants with low toxicity than synthetic antioxidants such as BHA and BHT [30]. Anjali and Sheetal conducted phytochemical screening and antioxidant activity studies with four medicinally important herbs like *Ocimum sactum* (Tulsi), *Mentha spicata* (Pudina), *Trigonella foenum – graecum* (Fenugreek) and *Spinacia oleracea* (Spinach)and proved that all the parts of the plants are highly therapeutic [31].

CONCLUSION

The plants were bestowed with many important phytochemicals which are responsible for their therapeutic role. The present day medicines owe their origin to plant products and plant extracts. In all the three Indian systems of medicine, Ayurveda, Siddha and Unani, most of the medicines are produced by herbal plants or their derivatives. All the traditional systems of medicine all over the world hinge on herbal medicine. The range of treatment by the medicinal plants ranges from common cold to cancer. The present day medicine is crippled due to the massive side effects they produce and poor affordability. Many synthetic antioxidant components have shown toxic and/or mutagenic effects, which have shifted the attention towards the naturally occurring antioxidants [23]. It is high time to search for medicines which are natural, with less or no side effects and are available at cheap cost [24].

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Conflict of Interest

Author's declares that they have no conflict of interest.

Ethical approval

This article does not contain any studies with human participants or animals performed by any of the authors.

Informed consent

For this type of study, formal consent is not required.

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Table 1: Taxonomic classification of *Hygrophila auriculata*

Kingdom:	Plantae
Clade:	Tracheophytes
Clade:	Angiosperms
Clade:	Eudicots
Clade:	Asterids
Order:	Lamiales
Family:	Acanthaceae
Genus:	*Hygrophila*
Species:	*auriculata*

Table 2: Yield and colour obtained of various extracts of *H.auriculata*

Sr. No.	Name of Extract	Yield (% w/w)	Colour of extract
1.	Hexane	0.5	Cream
2.	Chloroform	3	Brownish black
3.	Methanol	2	Reddish brown

Table 3: Results of Qualitative analysis of different extracts

	Test	Hexane	Ethyl acetate	Methanol
1	Carbohydrates test	+	+	+
2	Tannins test	+	+	+
3	Saponins test	+	+	+
4	Flavonoids test	+	+	+
5	Alkaloid test	-	+	+
6	Quinones test	+	+	+
7	Glycosides test	-	-	-
8	Cardiac glycosides test	+	+	+
9	Terpenoids test	+	+	+
10	Phenols test	+	+	+
11	Coumarins test	+	+	+
12	Steroids & Phytosteroids	+	+	+
13	Phlobatannins test	-	-	-
14	Anthraquinones test	-	-	-

+'– Present, '-'-Absent

Table 4: Estimation of Phenol and Flavanoids

Extracts	Quercetin equivalence for plant extracts (in µg/mg)	Gallic acid equivalence for Plant extracts (in µg/mg)
Hexane	94.85	197.84
Chloroform	87.23	134.14
Methanol	157.98	302.26

Table 5: Percentage Inhibition of Samples and PC

Sample no.	Sample name	Percentage Inhibition Concentration (µg/mL)					
		20	**40**	**60**	**80**	**100**	**PC**
1	**Hexane extract**	76.94	77.26	79.63	81.23	87.49	
2	**Chloroform extract**	72.76	77.34	80.24	84.59	88.61	
3	**Methanolic extract**	75.96	78.47	87.49	89.38	95.88	
4	**PC (Ascorbic acid-5µg/mL)**						94.73

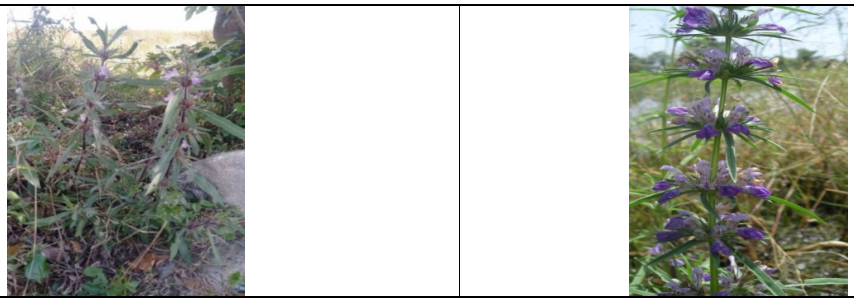
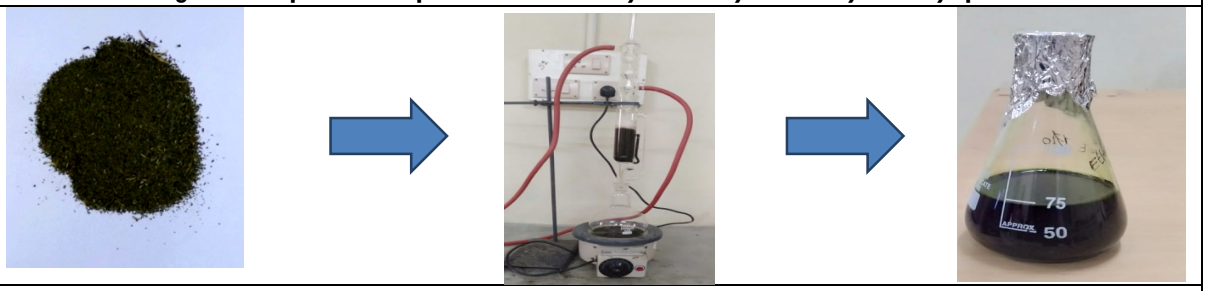


Fig 1: *Hygrophila auriculata* in the field surrounding AVIT campus

a) **b)** **c)** **d)**

Fig 2: Aerial parts of the plant *H.auriculata* a) Leaves b) Flowers c) Stem d) Spikes



Powdered leaves of *Hygrophila auriculata* **Extraction of phytochemicals using soxhlet apparatus** **Extract Obtained**

Fig 3: Extraction of leaves using soxhlet apparatus

Fig 4: Condensation of extracts in Rotary vacuum Evaporator

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RESEARCH ARTICLE

Antibacterial and Antifungal Activities of the Essential Oils Isolated from the Algerian *Mentha spicata* and *Foeniculum vulgare*

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ABSTRACT

Down the ages there has been an increasing interest in the use of plant extracts and essential oils as alternative remedies for the treatment of various infectious diseases, due to their antibacterial, antifungal and antiviral properties. This study aimed to evaluate the antibacterial and antifungal activity of *Mentha spicata* and *Foeniculum vulgare* essential oil (EO) collected from three locations on the West Coast of Algeria. The essential oil was extracted by hydrodistillation using Clevenger apparatus. The antibacterial and antifungal activity was tested against pathogenic strains gram-negative bacteria *Escherichia coli*, *Pseudomonas aeroginosa*, gram-positive bacterium *Staphylococcus aureus* and the fungus *Candida albicans* using the diffusion method, the minimum inhibitory concentration (MIC) and the minimum fungicidal concentration (MFC). The *Mentha spicata* essential oil shows the highest antibacterial activity than fennel EO, particularly the one gathered from Oran against *Staphylococcus aureus*, *Escherichia coli* (IZ= 22 mm) and *Candida albicans* (IZ= 35 mm). The *Foeniculum Vulgare* essential oil has an intermediate antibacterial and antifungal activity the highest inhibition zone diameters were shown against *Escherichia coli* (IZ= 17 mm). Antibacterial and antifungal activity of *Mentha spicata* and *Foeniculum vulgare* essential oils in the three sites is different. The present study indicated that the *Mentha spicata* and *Foeniculum vulgare* essential oil can be used as a potential source of natural antimicrobial and antifungal drugs.

Keywords : Algerian West Coast, Antibacterial activity, Antifungal activity, Essential oils, *Foeniculum vulgare*, *Mentha spicata*.

INTRODUCTION

Infectious diseases, a leading cause of untimely death worldwide have become a global concern. The clinical effectiveness of many existing antibiotics is being threatened by rapid emergence of multidrug resistant pathogens [1]. Down the ages there has been an increasing interest in the use of plant extracts and essential oils as alternative remedies for the treatment of various infectious diseases. Essential oils have been shown to possess antibacterial, antifungal, antiviral, insecticidal and antioxidant properties [2,3]. Essential oils are a group of volatile natural compounds, produced by secondary metabolism of aromatic plants [4]. In the field of anti-infectives, the discovery of new substances has always been the goal of Human, since the main cause of death in the past was infectious diseases [5]. Medicinal plants represent a potential source of novel therapeutic agents, being also the basis of indigenous healing systems, still widely used by the majority of populations in many countries [6].

Among the aromatic plants used in the phytotherapy, *Mentha spicata* (spearmint) that have a great importance, both medicinal and commercial. Actually, leaves, flowers and stems of *Mentha spicata* are often used in herbal teas or as additives in many food to offer aroma and flavour. In addition, it has been used as a traditional cure for the treatment of nausea, bronchitis, flatulence, anorexia, ulcerative colitis, and liver complaints due to its anti-inflammatory, carminative, antiemetic, diaphoretic, antispasmodic, painkiller and anticatarrhal activities [7]. The plant essential oil is obtained from freshly harvested mint leaves or from dried leaves, we can also use all the aerial parts of the plant by way of the distillation method. This plant with various therapeutic values such as antidiarrheal, cardiovascular, and nervous system effects, and antimicrobial, antioxidant, and anti-inflammatory activities has the hopeful potential as a medicinal herb [8].

Foeniculum vulgare (Fennel), botanically included in the Apiaceae familyis is a perennial and aromatic plant habitually used as a spice and traditional medicinal herb. It is used for coloring fabrics and cosmetic formulations because of its intense colors from leaves and flowers, in folk medicine it is used as a galactagogue [9] and for treating different medical conditions, such as flatulence, abdominal pain, gastritis, stomach pain, ulcers, diarrhea, vomiting, infantile colic, fever, cold, insomnia, conjunctivitis, arthritis, renal colic, liver disease, and various cancer types [10,11]. Despite the variability of the chemical composition of fennel essential oils, these are generally recognized for their pharmacological activities, such as stimulative, carminative, antioxidant, antibacterial [12], antiviral [13], antifungal [14], anxiolytic, sedative, antithrombotic, analgesic, anti-inflammatory and hepatoprotective [15]. In this context, the aim of this study was to improve the knowledge on the EOs obtained from these two aromatic plants procured from three regions on the West Coast of Alegria, evaluating their antibacterial properties against three pathogenic bacteria (*Staphylococcus aureus, Pseudomonas aeruginosa* and *Echerichia coli)* and their antifungal properties against *Candida albicans*.

MATERIALS AND METHODS

Plant material and EOs extraction

The aerial parts of *Mentha spicata* and *Foeniculum vulgare's* seeds were obtained from three places in northwestern Algeria (Oran, Mostaganem and Ain Temouchent), their harvest and distillation were carried out in July which is the best period for their better exploitation. Botanical identification of the species was carried out by a plant taxonomist. The Clevenger type apparatus was used for hydrodistillation [16]. During every extraction, the aerial parts of *Mentha spicata* and the seeds of Fennel and distilled water were placed in a one-liter capacity glass flask. The mixture was heated to boiling temperature for three hours or more and the liberated steams crossed up the column and passed out of the condenser in a liquid state. At the end of the distillation, two phases were observed, an aqueous phase (aromatic water) and an organic phase (EOs) less dense than water. The separation of the two phases is made by rotary evaporator. The obtained EOs were dried over anhydrous sodium sulfate and stored in the refrigerator at 4°C in dark glass bottles until use.

Antibacterial and antifungal activity

A screening of antibacterial and antifungal activity for *Mentha spicata* and *Foeniculum vulgare* essential oil separately was performed, using the disc diffusion method which has allowed the determination of the concentration giving a response classified as sensitive. The determination of the minimum inhibitory concentration (MIC) and the minimum fungicidal concentration (MFC) of each EO was made by the microdilution method in order to quantify its antimicrobial and antifungal power.

Test microorganisms

The antimicrobial and antifungal activity of the essential oil samples were tested towards pathogenic microorganisms. Two grams-negative bacteria, namely *Escherichia coli* ATCC 25922, *Pseudomonas aeruginosa* ATCC 27853 and gram positive bacterium namely *Staphylococcus aureus* ATCC 29923, the bacterial strains were obtained from the Oran Hospital Microbiology Laboratory (CHUO). *Candida albicans* is the only fungi used for the study which has been identified by the Pasteur Institute sited in Oran, Algeria.

Disc diffusion method

The disc diffusion method was used to test preliminarily the antibacterial and antifungal activity of EOs against the different strains, according to the protocol described previously by Mazzarrino [17], with few modifications. Briefly, a 0.5 McFarland (108 CFU/ml) of bacterial or fungic suspension was prepared in physiological water (0.9% NaCl) and inoculated by swabbing on sterilized petri dishes of Mueller-Hinton (MH) Agar for bacteria and Sabouraud agar for fungus. Then, 10 µl of each EO was dropped on 6 mm diameter sterile paper discs already deposited in the petri dishes, a disc with 10 µl of dimethylsulfoxide (DMSO) was used as a negative control. All petri dishes were incubated at 37°C for 24 h for bacteria and at 28°C for 2 days for fungus. Then, inhibition zone diameter was measured and expressed in millimeters (disc included). The presence of the inhibition zone indicates the activity of the tested samples against bacteria or fungi. The antibacterial activity was classified into three levels: weak (inhibition zone ≤12.0 mm), intermediate (12.1 mm ≤ inhibition zone ≤ 20.0 mm) and strong (inhibition zone ≥ 20.1 mm) [17].

Determination of minimum inhibitory concentration (MIC) and the minimum fungicidal concentration (MFC)

The MIC and MFC are the lowest concentrations of antifungal or antimicrobial substance that inhibits any visible growth after an incubation time of 24 hours to 48 hours. The MIC defines the sensitivity or resistance of bacterial strains to antimicrobial substances and MFC is the lowest concentration of extract that gives 99.99% inhibition [18], these have been tested according to Koneman et al and Derwich et al [19,20]. The dilution method made it possible to determine the CMI and the MFC thanks to the DMSO because the EO is not miscible in water. A range of four dilutions was performed (1/2, 1/4, 1/8, 1/16) in a concentration sequence of 25 mg/ml to 3.12 mg/ml of EOs to be tested. Using a sterile clamp, the 6 mm diameter steriles discs were put on MH agar for the CMI and on Sabouraud agar for the MFC, 10 µl of each essential oil dilution were dropped then on. The Petri dishes were then closed and allowed to diffuse at room temperature for 30 minutes and put in the oven at a temperature of 37C° for 48 hours for bacteria and at a temperature of 27C° for 5 to 7 days for fungi. The tests were repeated three times.

RESULTS

In order to determine a new source of natural antibiotics, this study focused on the evaluation of the antibacterial and the antifungal activity of *M. spicata* and *F. vulgare* in three locations in Algeria against gram-positive bacterium *S.aureus* (ATCC 25923) and gram-negative *P.aeruginosa* (ATCC 27853), *E.coli* (ATCC 25922) and fungus *C. albicans*. The DMSO negative controls showed no inhibition effects. Besides the inhibition zones reveal different susceptibility of different microorganisms to the both essential oils. The *Mentha spicata* essential oil shows the highest antibacterial activity against microorganisms than fennel EO. The highest zone diameters belonged to the *M.spicata* EO from Oran against *Staphylococcus aureus* and *Escherichia coli* (IZ= 20 mm) also against *Candida albicans* (IZ= 35 mm)(Fig. 1A). We

found out that gram-negative bacterium *P.aeruginosa* is resistant to *Mentha spicata* EO gathered from Oran and gram-positive bacterium *Staphylococcus aureus* is resistant to both *M. spicata* and *F. vulgare* EO gathered from Ain Temouchent. *Mentha Spicata*'s essential oil gathered from Oran has an important antibacterial activity with inhibition zones of 22 mm against *S.aureus* and *E.coli*. However, it shows no action against *P.aeruginosa* (Table 1). On the other hand, the oil is very useful as an antifungal against *Candida albicans* (Table 4). For the *Mentha Spicata* oil gathered from Mostaganem is considered a powerful antibacterial against *S.aureus* and *E.coli* (IZ= 20mm) and very effective against *P.aeruginosa* and *Candida albicans* (Table 2 and 4). As for the one from Ain Temouchent it has no action against *S.aureus*. However it has an intermediate antibacterial activity against *P.aeruginosa* and *E.coli*, it also presents an intermediate anti-candida activity.

The *Foeniculum Vulgare* essential oil from Oran has shown weak antibacterial activity against *S.aureus* and *P.aeruginosa,* intermediate activity against *E.coli* and *Candida albicans* (Table 1). As for the one obtained from Mostaganem, it has weak antibacterial activity against *S.aureus*, *P.aeruginosa* and *C.albicans.* On the other hand, it has an intermediate activity against *E.coli* (ZI=17mm) and *C.albicans* (Fig. 1B) (Table 4). Same results were found regarding Fennel EO harvested from Ain Temouchent no action against *S.aureus* and *C.albicans* (Table 4), weak activity against *P.aeruginosa,* intermediate activity against *E.coli* (Table 3). Antibacterial and antifungal activity of *M.spicata* and *F.vulgare* essential oils in the three sites is different, Oran's spearmint oil showed powerful antibacterial activity against *S.aureus* (IZ= 20mm) which is very superior to the ones of Mostaganem and Ain Temouchent. We noticed also that *S.aureus* is resistant to Ain Temouchent's *Mentha spicata* essential oil while sensitive to the one from Oran and Mostaganem, *P.aeruginosa* showed also resistance to this oil. As for the Fennel oil gathered from Ain Temouchent, we found out that *S.aureus* is resistant to it, while sensitive to the others. We observed the same thing in the anti-candida activity, there is a significant difference in the results at the three regions (Table 4).

DISCUSSION

According to the resources, previous researchers studied traditional herbal extracts from oils as an antibiotic agent with antiviral, antifungal, antimicrobial, analgesic, biodegradable and antioxidant activities. In the present study, the essential oil of spearmint has shown a powerful antifungal activity and intermediate antibacterial activity. Previous reports also revealed the antibacterial activity of the spearmint essential oils against *S. aureus*, *E. coli* and *Klebsiella spp* [21,22,23]. The inhibitory effect of spearmint oil against *Escherichia coli*, *Bacillus subtilis*, *Aspergillus niger* and *Candida albicans* has also been reported by Suleiman et al [24]. The *Foeniculum vulgare* essential oil has an intermediate antibacterial and antifungal activity in general. These data coincide with those of LoCantore et al [25] who reported that fennel essential oil displayed a significant antibacterial activity, as determined with the agar diffusion method, another study confirms our results which indicated that this oil has antibacterial activity against Gram-negative and Gram-positive bacteria [12]. *P.aeruginosa* had the lowest sensitivity to Oran's *Mentha spicata* essential oil. Low sensitivity of this Gram-negative bacterium to essential oils was reported in earlier studies [26,27,28]. This can be explained by the hydrophilicity of *P. aeruginosa* membrane's surface, through which only small and hydrophilic molecules can pass, unlike hydrophobic molecules (such as essential oils'components) that remain on the surface of the membrane [29].

Some studies reported that the essential oil extracted from fennel seeds exhibited antibacterial effect against food-borne pathogens such as *E. coli*, *Bacillus megaterium*, *S. aureus* [30,31], they also found that fennel essential oils possessed an inhibitory effect against a wide range of Bacillus species, which supported our results in the present study, indicating that essential oil of fennel seeds was a potent bacterial inhibitor with a broad antibacterial spectrum. We could not deny that the essential oil of *Mentha spicata* had a better antibacterial and antifungal activity on these pathogens microorganisms than fennel EO, this may be clarified by the fact that the antibacterial and antifungal activity of the essential oil relies on the kind of methods used for extraction. In addition, a link between the chemical structures of the most abundant compounds in essential oil has an impact on antimicrobial activity [32],

plus the chemical structure of certain compounds found in essential oils affects their antimicrobial character [2]. Lipophilic nature of these components is responsible for their antimicrobial and antifungal activity. Essential oil from the disintegrated fennel fruit also contains higher amounts of fenchone and limonene known as terpenes, the mechanism of the antibacterial effect of terpenes is not fully understood yet, but there are numerous studies that indicate they interact with the bacterial cell's membrane, terpenes are effective against both bacteria and fungi [33], which is confirmed also in this study. Due to its lipophilicity, fennel essential oil penetrates through skin and blood-brain barrier, so its action already begins by entering the human body, either by inhalation, ingestion or through the skin [29], so it can be an efficient component in different food and pharmaceutical products. Antibacterial and antifungal activity of *M.spicata* and *F.vulgare* essential oils in the three sites is different, this can be explained by the fact that there are factors like environmental, geographic and genetic variations, cultivation and processing methods which impact the chemical composition and subsequently biological activities. The use of medicinal plants to treat various illnesses caused by pathogenesis microorganisms is a very hopeful approach given their richness in bioactive molecules very numerous and varied according to species, which have shown antibacterial, antifungal, antileishmanial and antioxidant activities.

CONCLUSION

The present study indicated that the *Mentha spicata* and *Foeniculum vulgare* essential oil can be used as a potential source of natural antimicrobial and antifungal drugs. The both oils showed a highly activity against gram positive bacterium *S. aureus* (ATCC 25923) and gram-negative *P.aeruginosa* (ATCC 27853), *E.coli* (ATCC 25922) and fungus *C. albicans*. This is a resultant of the antibacterial properties of the major and minor components in their chemical composition. In this situation, more research is required for the enlightenment of the mechanisms determining the rise of the biological activity of essential oils, but also the synergized link between their components in order to use these plant as a possible bio-sourced in the food and pharmaceutical industries.

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Table 1. Minimal inhibitory concentrations and inhibition zone diameter of *Mentha spicata* and *Foeniculum vulgare* EOs against 3 different bacteria in Oran (Algeria)

	Diameter of the Zones of inhibition (mm)		minimum inhibitory concentration (mg/ml)	
Bacteria	*Mentha spicata*	*Foeniculum vulgare*	MIC *M.spicata*	MIC *F.vulgare*
S.aureus (ATCC 25923)	22	10	6.25	3.12
P.aeruginosa (ATCC 27853)	–	10	–	3.12
E.coli (ATCC 25922),	22	14	3.12	6.25

Note : Inactive (–)

Table 2. Minimal inhibitory concentrations and inhibition zone diameter of *Mentha spicata* and *Foeniculum vulgare* EOs against 3 different bacteria in Mostaganem (Algeria)

	Diameter of the Zones of inhibition (mm)		minimum inhibitory concentration (mg/ml)	
Bacteria	*Mentha spicata*	*Foeniculum vulgare*	MIC *M.spicata*	MIC *F. vulgare*
S.aureus (ATCC 25923)	20	12	12.5	6.25
P.aeruginosa (ATCC 27853)	12	8	25	6.25
E.coli (ATCC 25922)	20	17	12.5	3.12

Table 3. Minimal inhibitory concentrations and inhibition zone diameter of *Mentha spicata* and *Foeniculum vulgare* EOs against 3 different bacteria in Ain Temouchent (Algeria).

	Diameter of the Zones of inhibition (mm)		minimum inhibitory concentration (mg/ml)	
Bacteria	*Mentha spicata*	*Foeniculum vulgare*	MIC *M.spicata*	MIC *F.vulgare*
S.aureus (ATCC 25923)	-	-	-	-
P.aeruginosa (ATCC 27853)	14	10	25	6.25
E.coli (ATCC 25922),	16	16	12.5	3.12

Note : Inactive (–)

Table 4. Minimum fungicidal concentration (MFC) and inhibition zone diameter of *Mentha spicata* and *Foeniculum vulgare* EOs collected in the three stations in Algeria against *Candida albicans*.

	Diameter of the Zones of inhibition (mm)	MFC (mg/ml)
Mentha spicata EO of :		
Oran	35	12.5
Mostaganem	28	3.12
Ain Temouchent	14	3.12
Foeniculum vulgare EO of :		
Oran	8	3.12
Mostaganem	13	3.12
Ain Temouchent	-	-

Note : Inactive (–)

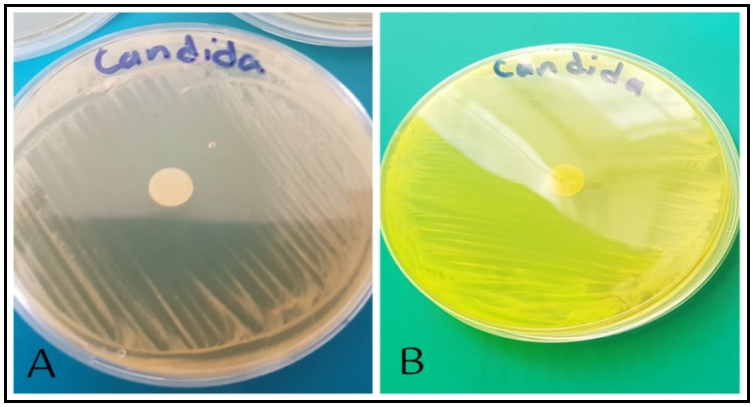

Figure 1. Anti-Candida activity of the *Mentha spicata (A)* and *Foeniculum vulgare (B)* essential oil

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RESEARCH ARTICLE

An Enhanced Method of Securing Data using Labeling

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ABSTRACT

Present day network security plays a major role in any organization. All the security features come under cybersecurity. The cybersecurity depends on AI and machine learning for securing data from brute force attacks. The AI functioning can be developed using cryptic technology called cryptography. Cryptography is the study of transforming messages into concealed data to unforeseen recipients. Cryptography is ubiquitous from smashed to encrypted email, internet security, digital signaling, image processing and even encrypted file systems. In this paper, we are going to adhere to the concept of labeling with cryptography. Labeling is the special class of Graph theory. Labeling of EIL is the label on edge with certain constructive forms to privacy the message. We also discuss the EIL concept with different acyclic graphs. Masking and revealing the message is done by asymmetric keys with a unique algorithm. The algorithm is based on alphabet numbering and function volume. Now let's investigate whether the message transmitted is safe from trespassers.
2010 Mathematical subject classification Number: 05C78.

Keywords: Edge Injective Labeling, Star graph, Coconut tree graph, Spider tree graph, Function volume, clue.

INTRODUCTION

Labeling and cryptography play an important role in protecting data or message. EIL is new and effective labeling injected on edges to get numerical value. A function volume is like a codebook. This book contains a lookup table where we can find a set of codes for words. In the year 1999, Simon Singh introduced the codebook. In the same way function volume is like a cryptic table that contains predefined functions for each numeric value. It is very easy and secure to cipher or decipher the message.

Researchers like[2] P.Jeyanthi, D.Ramya and P.Thangavelu discussed Mean Labeling on various graphs, [1] Tamilselvi.M, Akilandeswari.K, Durgalakshmi.N, investigated k-Super Mean Labeling of $(C_m, K_{1,n})$ and $(C_m * K_{1,n})$. [3] A.Lourdusamy and Sherry George gave a detailed study about Super vertex Mean Labeling of cycles through different ways. [4] G.UmaMaheswari, G.Margaret Joan Jebarani and V.Balaji, encoded and decoded messages through two stars and Super Mean Labeling. Getting inspired by the above research work we encoded the message using edge injective labeling on acyclic graphs.

Edges Injective Label (EIL)

Let G(V,E) be a graph and with vertices $f : V(G) \rightarrow$ { 1, 2, 3, …26} be an injection vertex set which results in the induced edge set as

$y = 3X - 1;$ *if* $1 \leq y \leq 26$

$y = (3X - 1) mod\ 26;$ *if* $y \geq 26$

$y = (3X - 1) mod\ 26 = 0;$ *Exclude the case*

2.1. Definition

A cyclic graph is a special type of graph. A graph that contains at least one cycle or circular form is called Cyclic Graphs. Otherwise, a cyclic graph is a graph that contains a path from at least one vertex back to itself.

2.2. Definition

An acyclic graph is a graph that does not contain any cycle graph that is no vertex can be traversed back to itself. Using Edge Injective Labeling we investigate a family of the acyclic graphs.

Clue

The Clue is a piece of information given to the receiver to break the coded message.

3.1. Function Volume

Function volume is a book that consists of a sequence of letters, symbols, numbers, a set of functions and partial numbers with fixed expressions. Each entry is assigned as a code in this book. Function volume is used to encode and decode the labels in the graph.

3.2. Algorithm for encoding

Step 1: A message will be given
Step 2: The 26 English alphabets are numbered in a unique way
Step 3: Draw the graph pattern
Step 4: Label the edges using edge injective labeling
Step 5: Repetitions of labels are not allowed
Step 6: Labels are related with numbering in alphabets
Step 7: Then we see the graph for the location of alphabet numbers and we encode the message

3.3. Algorithm for decoding

Step 1: From the clue draw the diagram and number the alphabets
Step 2: The 26 English alphabets are numbered in a unique way

Step 3: The encoded message is used to find the position and the exact number
Step 4: Function volume is used to find the labels of the graph pattern
Step 5: The exact number gives each letter of the message

Star graph

A star graph is a graph connected with pendant k vertices. Otherwise, we can say it is a tree with a center vertex connecting all other vertices with vertex degree k-1.

4.1. Theorem

A graph that admits EIL is a Star graph when $n \leq 10$.

Proof

Let $K_{l,n}$ be the star graph with $n+1$ vertices and n edges where $n \leq 10$.

To prove $K_{l,n}$ admits EIL labeling.

Let us consider $f : V(G) \rightarrow \{1, 2, 3, \ldots 100\}$ be the vertices. Then the corresponding induced edge injective labels are

$y = 3X - 1;$ $\quad if\ 1 \leq y \leq 26$
$y = (3X - 1) mod\ 26;$ $\quad if\ y \geq 26$
$y = (3X - 1) mod\ 26 = 0;$ $\quad Exclude\ the\ case$

Therefore the Star graph is EIL.

4.2. Example

An EIL of Star graph

Encryption

1. Message: Soldier shot at border

Let us consider different alphabet numbering patterns by reversing the numbers.

2. Alphabets numbering: Starting from A to Z we assigned numbers 1- 26.

3. Graphical encoding: We are now going to encode the given message using a Star graph of K1,10 with the Edge injective labeling technique. Labeling of edges can be seen in Fig. 1.

4. Encoding pattern using Star graph

Notation

P $\rightarrow$ Top Vertices

F $\rightarrow$ Edges

S $\rightarrow$ Pendant Vertices

S	O	L	D	I	E	R	S	H	O
S_7	F_6	F_9	S_2	F_5	S_3	F_{10}	S_7	F_1	F_6
T	A	T	B	O	R	D	E	R	
F_4	P	F_4	S_1	F_6	F_{10}	S_2	S_3	F_{10}	

5. Horizontal string: Encoded messages will be in the form of horizontal strings.

$$S_7F_6F_9S_2F_5S_3F_{10}S_7F_1F_6F_4PF_4S_1F_6F_{10}S_2S_3F_{10}$$

6. Decryption: The receiver will get a message as a horizontal string.

$$S_7F_6F_9S_2F_5S_3F_{10}S_7F_1F_6F_4PF_4S_1F_6F_{10}S_2S_3F_{10}$$

To decode the message clue and Function Volume will be given.

Clue: 1. 1-26 is numbered from front to back
2. Twinkle 10VE1P (Star graph of ten vertices, edges and one pendant vertex
3. Notation

P ⟶ Top Vertices
F ⟶ Edges
S ⟶ Pendant Vertices

Functions Volume

P- 8n

n values	1	2	3	4	5	6	7	8	9	10
Function (S_n)	$2n$	$2n$	$n+2$	$n+2$	$2n+1$	$2n+1$	$2n+5$	$2n+6$	$4n+2$	$4n$
Function (F_n)	$8n$	$7n$	$5n+2$	$5n$	$n+4$	$2n+3$	n	$2n$	$n+3$	$n+8$

Using the clue the receiver draws the Star graph and labeling will be done by function volume. Then the receiver applies notation to find the exact position and numbering of the encoded message. At last, the receiver matches the number with alphabet numbering and finds the exact message that "Soldier shot at border".

Coconut Tree graph

An end vertex of a path graph P_n is attached with successive pendant edges. Then the graph is called the Coconut tree graph.

5.1. Theorem

A graph which admits EIL is Coconut tree graph when $u \geq 2$, $v \geq 2$.

Proof:

Let $V = \{v_k : 1 \leq k \leq u\} \cup \{v_l : 1 \leq l \leq v\}$ be the vertex set of the graph where v_k denotes u vertices of the path P_u and v_l denotes the new pendant vertices at an end vertex of the path P_u.

Let $E = \{v_k + v_{k+1} : 1 \leq k \leq u\} \cup \{v_k v_l : k = u, 1 \leq l \leq w\}$ be the edge set of graphs. Here the coconut tree graph contains $s = u + w$ vertices and $t = u + w - 1$ edges.

Now we define an edge injective function as

$y = 3X - 1;$ $\quad if\ 1 \leq y \leq 26$
$y = (3X - 1) mod\ 26;$ $\quad if\ y \geq 26$
$y = (3X - 1) mod\ 26 = 0;$ $\quad Exclude\ the\ case$

Case (i): When $E = y = 3(v_k + v_{k+1}) - 1$ is less than 26 we label the edge as it is.

Case (ii): When $E = y = 3(v_k + v_{k+1}) - 1$ is greater than 26 we calculate modulo of 26. Then we fix the value as an edge label.

Case (iii): When $E = y = 3(v_k + v_{k+1}) - 1$ is equal to zero and we exclude the case and do not consider that $V = v_k + v_{k+1}$.

Therefore the graph CT is EIL.

5.2. Example

An EIL of Coconut tree graph

Encryption

1. Message: Walmart is a retail corporation store located in America
Let us consider different alphabet numbering patterns by reversing the numbers.

2. Alphabets numbering: 26-1 is numbered from back to front.

3. Graphical encoding: We are now going to encode the given message using a Coconut tree graph of eleven vertices and ten edges with an Edge injective labeling technique. Labeling of edges can be seen in Fig. 2.

4. Encoding pattern using Coconut tree graph

Notation

P ⟶ Top Vertices

F ⟶ Edges

S ⟶ Pendant Vertices

TF ⟶ Tail Edges

TS ⟶ Tail Vertices

W	A	L	M	A	R	T	I	S	A	R	E	T
TS_4	S_3	S_1	TF_1	S_3	S_4	S_6	F_6	P	S_3	S_4	S_2	S_6
A	I	L	C	O	R	P	O	R	A	T	I	O
S_3	F_6	S_1	F_4	TS_1	S_4	F_2	TS_1	S_4	S_3	S_6	F_6	TS_1
N	S	T	O	R	E	L	O	C	A	T	E	D
S_7	P	S_6	TS_1	S_4	S_2	S_1	TS_1	F_4	S_3	S_6	S_2	F_3
I	N	A	M	E	R	I	C	A				
F_6	S_7	S_3	TF_1	S_2	S_4	F_6	F_4	S_3				

5. Horizontal string

Encoded messages will be in the form of horizontal strings.

$$TS_4S_3S_1TF_1S_3S_4S_6F_6PS_3S_4S_2S_6S_3F_6S_1F_4TS_1S_4F_2TS_1S_4S_3S_6F_6TS_1$$

$$S_7PS_6TS_1S_4S_2S_1TS_1F_4S_3S_6S_2F_3F_6S_7S_3TF_1S_2S_4F_6F_4S_3$$

6. Decryption

The receiver will get a message as a horizontal string.

$$TS_4S_3S_1TF_1S_3S_4S_6F_6PS_3S_4S_2S_6S_3F_6S_1F_4TS_1S_4F_2TS_1S_4S_3S_6F_6TS_1$$

$$S_7PS_6TS_1S_4S_2S_1TS_1F_4S_3S_6S_2F_3F_6S_7S_3TF_1S_2S_4F_6F_4S_3$$

To decode the message clue and Function Volume will be given.

Clue

1. 26-1 is numbered from back to front
2. Web 1P3TV7V10E (Coconut tree graph of eleven vertices and ten edges)
3. **Notation**

P ⟶ Top Vertices

F ⟶ Edges

S ⟶ Pendant Vertices

TF ⟶ Tail Edges

TS ⟶ Tail Vertices

Functions Volume

n values	1	2	3	4	5	6	7
Function P	$8n$						
Function TS_n	$12n$	$3n$	$n+1$				
Function TF_n	$14n$	$n-1$	n				
Function S_n	$15n$	$11n$	$8n+2$	$n+5$	$3n+4$	$n+1$	$2n-1$
Function F_n	$15n+1$	$5n+1$	$5n+8$	$5n+4$	$n-3$	$3n$	$n+3$

Using the clue the receiver draws the Coconut tree graph and labeling will be done by function volume. Then the receiver applies notation to find the exact position and numbering of the encoded message. At last, the receiver matches the number with alphabet numbering and finds the exact message that "Walmart is a retail corporation store located in America".

Spider Tree Graph

A Spider tree graph is a tree with one vertex of degree greater than three and all other vertices are of degree two.

6.1. Theorem

A graph that admits EIL is a Spider tree graph with u legs and length l.

Proof

Let $V = \{v_k\} \cup \{v_{kl} : 1 \le k \le u, 1 \le l \le w\}$ be the vertex set of the graph where v denotes the center vertex and v_{kl} denotes the u legs and l denotes the length of the spider tree graph.

Let $E = \{v_k + v_{kl+1} : 1 \le k \le u, 1 \le l \le z-1\} \cup \{vv_{kl} : 1 \le k \le u\}$ be the edge set of graphs. Here the Spider tree graph contains $s = ul + 1$ vertices and $t = ul$ edges.

Now we define an edge injective function as

$y = 3X - 1;$ $\quad if\ 1 \le y \le 26$

$y = (3X - 1) mod\ 26;$ $\quad if\ y \ge 26$

$y = (3X - 1) mod\ 26 = 0;$ $\quad Exclude\ the\ case$

Case (i): When $E = y = 3(v_k + v_{kl+1}) - 1$ is less than 26 we label the edge as it is.

Case (ii): When $E = y = 3(v_k + v_{kl+1}) - 1$ is greater than 26 we calculate modulo of 26. Then we fix the value as an edge label.

Case (iii): When $E = y = 3(v_k + v_{kl+1}) - 1$ is equal to zero. We exclude the case and do not consider that $V = v_k + v_{kl+1}$. Therefore the Spider tree graph is EIL.

6.2. Example

An EIL of Spider tree graph

Encryption

1. Message: Form a fire to the left side

Let us consider different alphabet numbering patterns by reversing the numbers.

2. Alphabets numbering: 26-1 is numbered from back to front.

3. Graphical encoding: We are now going to encode the given message using a Spider tree graph of eleven vertices and ten edges with the Edge injective labeling technique. Labeling of edges can be seen in Fig. 3.

4. Encoding pattern using Spider tree graph

Notation

P $\longrightarrow$ Top Vertices

F $\longrightarrow$ Edges

S $\longrightarrow$ Pendant Vertices

F	O	R	M	A	F	I	R	E	T
F_1	F_9	F_7	F_6	F_4	F_1	S_2	F_7	F_5	F_3
O	T	H	E	L	E	F	T	S	I
F_9	F_3	S_3	F_5	S_1	F_5	F_1	F_3	S_4	S_2
D	E								
F_{10}	F_5								

5. Horizontal string

Encoded messages will be in the form of horizontal strings.

$$F_1F_9F_7F_6F_4F_1S_2F_7F_5F_3F_9F_3S_3F_5S_1F_5F_1F_3S_4S_2F_{10}F_5$$

6. Decryption

The receiver will get a message as a horizontal string.

$$F_1F_9F_7F_6F_4F_1S_2F_7F_5F_3F_9F_3S_3F_5S_1F_5F_1F_3S_4S_2F_{10}F_5$$

To decode the message clue and Function Volume will be given.

Clue: 1. 26-1 is numbered from back to front

2. Web 11V10E1P (Spider tree graph of eleven vertices and ten edges)
3. Notation

P $\longrightarrow$ Top Vertices

F $\longrightarrow$ Edges

S $\longrightarrow$ Pendant Vertices

Functions Volume

n values	1	2	3	4	5	6	7	8	9	10
Function (S_n)	$15n$	$9n$	$6n+1$	$2n$	$5n-1$	$2n+4$	$2n+6$	$2n+1$	$n-4$	n
n values	1	2	3	4	5	6	7	8	9	10
Function (F_n)	$21n$	$2n$	$n+4$	$6n+2$	$5n-3$	$2n+2$	$n+2$	$n-5$	$n+3$	$2n+3$

Using the clue the receiver draws the Spider tree graph and labeling will be done by function volume. Then the receiver applies notation to find the exact position and numbering of the encoded message. At last, the receiver matches the number with alphabet numbering and finds the exact message that “Form a fire to the left side”.

CONCLUSION

In this paper, we have completed data coding through Star, Coconut tree and Spider tree graphs. Similar problems can be investigated for other families of graphs. We interpreted the message into ciphertext using a graph. This research is meant for contacting any person with a message of the high seal of secrecy, intricacy, complexity and self-reliance. In our future work, we would like to apply coding techniques to AI.

Application

Acyclic graphs are mainly used in data processing networks. Among acyclic graphs, the Star graph is mainly used in networking the server. Through networking channels, it is easy to communicate with each other. Google, Social media and Whatsapp work with the technology of networking channels. Also, it is used in blockchain technology, GPS tracking systems, construct integrated circuits, assembly of genomes in Biology and many more. This networking technology can be crafted by AI mode using built-in machine learning and network packets.

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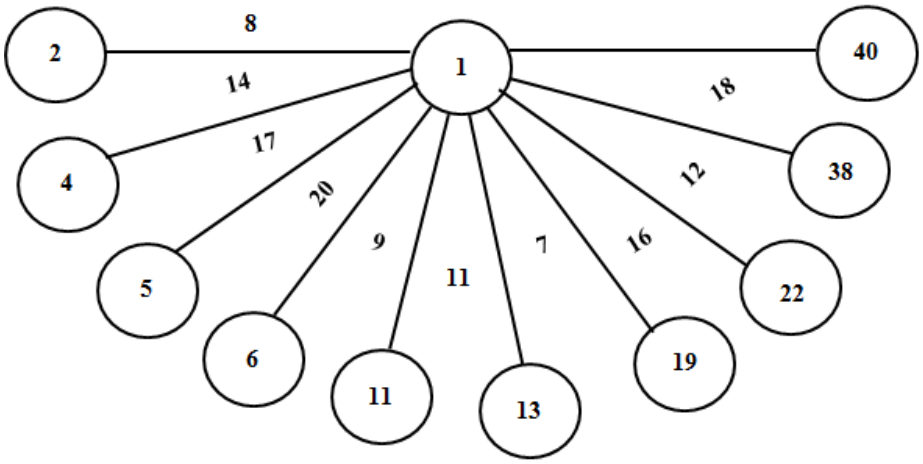

Figure 1: Star Graph

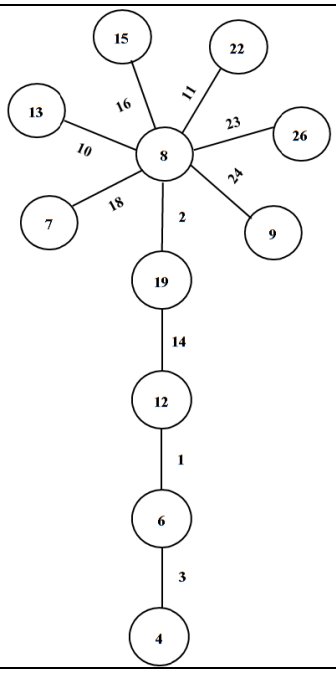

Figure 2: CT graph

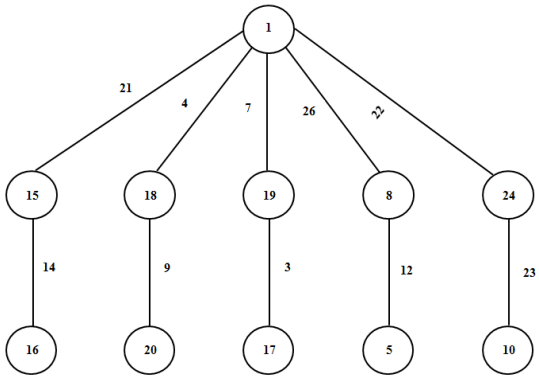

Figure 3: Spider tree graph

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RESEARCH ARTICLE

A Comparative Study on the Effectiveness of Myofascial Release Technique Versus Cyriax Massage in Reducing Pain and Improving Grip Strength in Patients with Lateral Epicondylitis.

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ABSTRACT

The purpose of the study is to compare the effect of Myofascial Release Technique versus Cyriax Massage in reducing pain and improving grip strength in patients with Lateral Epicondylitis. 30 subjects were selected who had Chronic Lateral Epicondylitis with unilateral involvement between the age group of 20-30 of both the sexes were only selected for the study by simple random sampling method and were divided into two equal groups. Pretest assessment of pain and hand grip was taken using visual analogue scale and Hand-Held Dynamometer. After the pretest the experimental group I received Myofascial release technique and the experimental group II Cyriax massage for a period of 3 weeks. The treatment was given once a day for the group. On the 21st day Posttest measurement was taken for the group in a similar fashion as that of pretest measurement.

Keywords: Tennis Elbow, Lateral Epicondylitis, Myofascial Release, Cyriax Massage, Deep Transverse Friction Massage, Pain, Grip Strength.

INTRODUCTION

Tennis elbow was first described in 1883 by Major [1] as a condition causing lateral elbow pain in tennis players. The prevalence ranges from 1% to 3% in the overall population [2] and is highest in the 20 to 45-year age group [3]. Lateral epicondylitis is the most common lesion which occurs at elbow [4]. Pain in the lateral epicondyle or wrist extensor muscles origin is termed as Lateral Epicondylitis [5].The earlier studies give us a result that due to repeated wrist movements extensor carpi radialis brevis is found to be affected. The tendon tear between the muscle and bone

junction leads to a poor healing of the tissues because of overlying periosteal tissues. Repetitive movement creates micro trauma which may occur due to overuse or biomechanical dysfunction which in turn leads to overload of the repairing tissues, this mechanically distort scar tissue and thus stimulate free nerve endings to evoke mechanical nociceptive pain [6]. There will be a fibroblastic proliferation of the tendon which will result in degenerative process that results in acute inflammation [7].This is further compounded by the head of the radius which rotates anteriorly against extensor carpi radialis brevis during pronation of the forearm. Many individuals may experience pain at the head of the radius during pronation which is due to irritation of the underlying bursa [14]. Pain at the common extensor origin of the elbow is the main symptom of lateral epicondylitis.

The pain is exacerbated by passive extension of the elbow with the wrist in flexed position and by resisted extension of the wrist in the elbow extended position [8].Gripping is impaired, most notably when strength is required, so that holding a object or giving a handshake may be painful and difficult to accomplish. Thus, the patient is at a disadvantage in many situations and may experience difficulty with activities of daily living. Statistical data indicate that lateral epicondylitis is associated with many lost days of work and with residual impairments associated with prolonged limitations in work capabilities [9,10]. Myofascial Release Technique [MFR] is being used to treat patients with Lateral Epicondylitis, but there are few formal reports which states its success rate. MFR is the application of a low load, long duration stretches to the myofascial complex, intended to restore optimal length, decrease pain and improving the hand grip [11].

Direct technique MFR is thought to work directly on the restricted fascia. physiotherapist use the knuckles or finger tips or other tools to slowly sink into the fascia, and the pressure applied in a few kilograms of force to contact the restricted fascia and stretch the fascia. Indirect MFR involves application of gentle stretch- the pressure applied over a few grams of force, and the hands tend to follows the direction of fascial restriction, hold the stretch, and allow the fascia to 'unwind' itself. The ratio for these techniques can be traced to various studies that investigated plastic, viscoelastic, and piezoelectric properties of the connective tissue [15,16].Cyriax massage which is otherwise called as Deep Transverse Friction Massage [DTF massage]. The application of Deep Transverse Friction Massage [DTF massage] produces therapeutic benefits by breaking down the adhesions and improve circulation between the repairing connective tissue and surrounding tissues, thus softening the scar tissue and mobilizing the cross-links between the mutual collagen fibers [12]. Moreover, DTF massage produces vasodilatation and increased blood circulation to the affected area. This facilitates the removal of chemical irritants and increases the transportation of endogenous opiates, resulting in a decrease in pain [13].

MATERIALS AND METHODS

The study is experimental in nature. 30 subjects were selected using simple random sampling method and were divided into two equal group. Subjects who had Chronic Lateral Epicondylitis with unilateral involvement and are psychologically fit, between the age group of 20-30 were only selected for the study. Both males and females were included and subjects with other associated problems were not included for the study. Informed consent was obtained from the subjects and then only they were included for the study. Pretest assessment of pain was taken using visual analogue scale, which consisted a 10cm unmarked line marked as no pain on one end and another end as severe pain. Patients were asked to extend the wrist against resistance and then plot a mark on the visual analogue scale which represents their intensity of pain. Pretest assessment of hand grip was done by asking the patients to hold the Hand-Held Dynamometer and then do a Grip. The grip strength is measured as readings in Kg which is shown in Hand-Held Dynamometer. After the pretest assessment Experimental Group I received Myofascial Release Technique in which the patient was made to lie in supine lying, shoulder in medial rotation, elbow in pronation and flexion to around 15°, palm resting flat on the treatment table and therapist was standing on the side of the treatment table at the level of the patient's shoulder and facing the ipsilateral hand [17,18]. Procedure 1- This procedure is given from the common extensor tendon origin to the extensor retinaculum of the wrist, the therapist began on the

humerus, just proximal to the lateral epicondyle. The therapist used the finger pads to engage the periosteum and carried this and contact inferior to the common extensor tendon origin and then down to the extensor retinaculum of the wrist. Patients were trained to slowly flex and extend the elbow within an easy range of 5° to 10° during this procedure (5min, 2 repetitions). Procedure 2- This procedure is done through the periosteum of the ulna, the therapist used the knuckles of the hand to work over the periosteum of the ulna. Patients were trained to do alternating ulnar and radial deviation of the wrist while periosteum of ulna being engaged (5min, 2 repetitions). Procedure 3- This procedure is done to the radius from the ulna, the therapist contacts the head of the ulna with the finger pads of one hand and the dorsal tubercle of radius with the finger pads of the other.

The therapist was engaged through to the periosteum and put a line of tension in a lateral and distal direction of the radius and ulna. This was carried for a few centimeters with a firm intent to spread the bones apart (5min, 2 repetitions). Total 30 minutes session given once a day for 21 days. For the experimental group II, Cyriax technique, was given in which the patients were made to sit comfortably with elbow in 90 degrees of flexion. The therapist stood on the affected side and identified the area of tenderness. The investigator applied the transverse friction massage with his tip of index finger and reinforcing by the middle finger. The transverse friction was applied at right angles to the fibers comprising the tissue containing the lesion with sufficient amplitude and right amount of pressure. The investigator's finger moves forwards and backwards across the muscle. The investigator's finger and the patient's skin moved together as one. The patient's skin must be dry and grease-free in order to avoid any slipping between those two. The friction was maintained for five to ten minutes but the area should be examined at intervals to check redness and bruising. The technique was applied once a day for 21 days. The post-test assessment of pain and grip strength was collected at the end of third week for both the group in a similar manner as that of pre-test measurement. The collected data was subjected to statistical analysis using paired "t" test (Table 1, 2) and independent "t" test (Table 3).

RESULTS AND DISCUSSION

The data subjected to statistical analysis using paired "t" test for 9 degrees of freedom at 95% confident level had revealed that the Myofascial Release Technique is significantly effective in reducing pain and improving grip strength on patients with lateral epicondylitis. Cyriax technique is also significantly effective in reducing pain and improving grip strength on patients with lateral epicondylitis. Myofascial Release Technique is significantly more effective in reducing pain and improving grip strength than Cyriax technique on patient with lateral epicondylitis. Myofascial release technique is significantly effective in reducing pain and improving grip strength in Lateral Epicondylitis may be because the analgesics effect of MFR can also be attributable to the stimulation of ascending pathways and the excitation of afferent large diameter A delta fibers, which can cause segmental pain modulation[19] as well as modulation through the activation of descending pain inhibiting systems.[20] However, the follow-up at week 12 has shown that the treatment effects were less evident compared with week 4 after the treatment.

Myofascial release technique helps to reduce pain, by application of the treatment where there will be substantial elongation of the fascia and the fascia backs to its normal length, studies has also provided evidences that MFR is more effective in controlling pain. Studies done by Ajimsha et al., 2012 and Khuman et al. 2013 has shown similar results to our study, that MFR plays a major role in reducing pain and improving functional performance and grip strength in Lateral Epicondylitis. [17,18]. Myofascial release therapy play a major role in relaxing the deeper tissues in the body and provides lasting and effective relief of pain [17]. When pain reduces there will be reduction of the muscle tightness and the muscles were relaxed and produce good amount of contraction and thereby improving the Grip Strength. Cyriax technique was also significantly effective in reducing pain on patients with lateral epicondylitis may be because they will cause presynaptic inhibition at spinal cord level and inhibit pain by the central production of enkephalin. In the past this phenomenon was called "Massage Analgesia".Cyriax1980,Cyriax

stated that deep transverse massage causes production of traumatic hyperemia which enhances blood supply to the area which in turn diminishes pain by decreasing the speed of destruction of lewis P substance which is an irrirative metabolite produced, due to histamine release. C.Williams et al., [1989], Stated that deep transverse friction causes minor damage for normal tissues, resulting in the release of inflammatory chemicals such as histamine and bradykinin. The inflammatory chemicals will cause a local vasodilatation. This lasts for some considerable time and may in itself have beneficial effects for accelerating repair in acute lateral epicondylitis. For the above said reasons, Cyriax technique is significantly effective in reducing pain and improving grip strength in Lateral Epicondylitis but Myofascial release technique is significantly more effective than Cyriax technique in reducing pain and improving grip strength in Lateral Epicondylitis.

CONCLUSION

The results of the study make us to conclude that Myofascial Release Technique is significantly more effective in reducing pain and improving grip strength on patient with lateral epicondylitis than Cyriax technique.

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CONFLICT OF INTEREST

The authors have none to declare.

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Table 1: Paired t test for experimental group I Myofascial Release Technique

Variable	't' tab value	't' cal value
Pain	2.145	9.357
Grip Strength	2.145	13.264

Table 2: Paired 't' test for experimental group –II (Cyriax massage)

Variable	't' table value	't' cal value
Pain	2.145	5.580
Grip Strength	2.145	8.264

Table 3: Independent 't' test

Variable	't' table value	't' cal value
Pain	2.050	4.247
Grip Strength	2.050	5.101

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RESEARCH ARTICLE

The GC MS Study of One Ayurvedic Medicine, Kachuradi Churnam

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ABSTRACT

The present study embarks upon the GC MS analysis of one Ayurvedic formulation, Kachuradi churnam prescribed for treating headache, dizziness, sleeplessness and stress. The medicine was procured from standard Ayurvedic vendor at Chennai and was processed as per standard protocol and subjected to GC MS analysis. The GC MS profile indicated the presence of some molecules such as .alpha.-Cubebene, 1H-Cyclopenta[1,3]cyclopropa[1,2]benzene, octahydro-7-methyl-3-methylene-4-(1-methylethyl)-, [3aS-(3a.alpha.,3b.beta.,4.beta.,7.alpha.,7aS*)]-, trans-calamenene, 1H-Cycloprop[e]azulen-7-ol, decahydro-1,1,7-trimethyl-4-methylene-, [1ar-(1a.alpha.,4a.alpha.,7.beta.,7a.beta.,7b.alpha.)]-, Tridecanoic acid, 12-methyl-, methyl ester, i-Propyl 5,8,11,14,17-eicosapentaenoate, Ethyl (1R,4S)-1,7,7-trimethylbicyclo[2.2.1]heptan-2-yl carbonate, .gamma.-Sitosterol, .beta.-Amyrin and .alpha. -Amyrin etc. which indicate medicinal role supporting the claim that Chandanasavam helps towards relieving the ailments. It is concluded that Kachuradi churnam does contain medicinally significant molecules which could deliver its medicinal function in relieving the ailments.

Keywords: Kachuradi churnam, GC MS, Ayurvedic, .alpha.-Cubebene, .gamma.-Sitosterol, .beta.-Amyrin,. alpha.-Amyrin.

INTRODUCTION

Most of the world population depends on alternative and traditional medicines for their health problems. Although time tested and in vogue for thousands of years, the efficacy, authenticity and usefulness for these medicinal forms are subject to criticism due to lack of scientific validation and standardization. It is high time to look into this angle to prove their efficacy. Among the modern methods of testing, GC MS is one technique which helps us to probe into the molecules present in any medicine. In order to bring this knowledge forth, the present workers have reported the GC MS results of some Ayurvedic drugs and the work still continues [1-25]. The present work deals with the GC MS study of one Ayurvedic medicine, Kachuradi Churnam. Kachuradi Churnam is an Ayurvedic medicine prescribed for external application on forehead to relive headache, dizziness, sleeplessness, burning sensation of eyes, stress and giddiness. It is also used for children with cerebral palsy and autism. It finds its reference in the Ayurvedictreatise, Sahasrayogamchoornaprakaranam. It consists of equal parts of the powders of the following ingredients.

Kachora – *Curcuma zedoaria*, Dhatri – *Emblica officinalis*, Manjishta – *Rubia cordifolia,* Yashti – *Glycyr rhizaglabra*, Daru – *Cedrus deodara*, Silajitu – Asphaltum, Vedhi – *Ferula foetida*, Rohini – *Andrographis paniculata*, Tintrinisira – *Tamarindu sindicus*, Kumkuma – *Crocus sativus*, Indu – *Camphor varivaha* – *Cyperus rotundus*, Rochanam – *Mallotus phillippenensis*, Bala – *Sida cordifolia*, Laja – *Oryza sativa*, Jala – *Coleus zeylanicus*, Usira – *Vetiveria zizanioides* and Pushkaramoola– *Inula racemosa.* The powders are mixed and applied on the fore head and scalp after mixing with breast milk or any other suitable ayurvedic oils, such as Kheerabala oil. This powder is manufactured by The Arya Vaidya Nilayam, Ashoka Pharmaceuticals, Arya Vaidya Sala Kottakkal, Arya Vaidya Pharmacy, SNA Oushadasala Pvt Ltd, among others.

MATERIALS AND METHODS

Kachuradi churnam was obtained from standard Ayurvedic vendor at Chennai and was subjected to GC MS analysis by standard procedure. 100 micro lit sample Dissolved in 1 ml of suitable solvents. The solution stirred vigorously using vortex stirrer for 10 seconds. The clear extract was determined using gas-chromatography for analysis. The compounds are identified by GC-MS Library (NIST & WILEY).

RESULTS AND DISCUSSION

The GC MS profile of Kachuradi churnam is represented in Figure 1. Table1 indicates the retentions values, types of possible compound, their molecular formulae, molecular mass, peak area and their medicinal roles of each compound as shown in the GC MS profile of Kachuradi churnam. The identification of metabolites was accomplished by comparison of retention time and fragmentation pattern with mass spectra in the NIST spectral library stored in the computer software (version 1.10 beta, Shimadzu) of the GC-MS along with the possible pharmaceutical roles of each bio molecule as per Dr. Duke's Phytochemical and ethnobotanical data base (National Agriculture Library, USA) and others as shown in Table 1 [26].

The molecules shown in Table 1 such as .alpha.-Cubebene, 1H-Cyclopenta[1,3]cyclopropa[1,2]benzene, octahydro-7-methyl-3-methylene-4-(1-methylethyl)-, [3aS-(3a.alpha.,3b.beta.,4.beta.,7.alpha.,7aS*)]-, trans-calamenene, 1H-Cycloprop[e]azulen-7-ol, decahydro-1,1,7-trimethyl-4-methylene-, [1ar-(1a.alpha.,4a.alpha.,7.beta.,7a.beta.,7b.alpha.)]-, Tridecanoic acid, 12-methyl-, methyl ester, i-Propyl 5,8,11,14,17-eicosapentaenoate, Ethyl (1R,4S)-1,7,7-trimethylbicyclo[2.2.1]heptan-2-yl carbonate, .gamma.-Sitosterol, .beta.-Amyrin and .alpha.-Amyrin do show some important medicinal roles which can relieve the ailment as claimed by

Ayurvedic medical concept. Further work on the roles of each molecule as well as those molecules whose medicinal roles are unknown is warranted.

CONCLUSION

From the above results and discussion it is clear that Kachuradi churnam does contain some very important biomolecules whose roles augur well with that of Kachuradi churnam.

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Table 1. Indicates the retentions time, types of possible compound, their molecular formulae, molecular mass, percentage peak area and their medicinal roles of each compound as shown in the GC MS profile of Kachuradi Churnam

Sl. No	Retention Time	Compound Name	Mol. Formula	Mol. Weight	% Peak Area	Possible medical Role
1	4.57	Bicyclo[2.2.1]heptan-2-ol, 1,5,5-trimethyl-	C10H18O	154.1	1.02	Not known
2	4.97	Bicyclo[2.2.1]heptan-2-one, 1,7,7-trimethyl-, (1S)-	C10H16O	152.1	0.58	Not known
3	5.19	Isoborneol	C10H18O	154.1	41.36	Isoborneol, a derivative of borneol is reported to have antiviral properties on herpes simplex virus 1 (HSV-1)[27]
4	5.72	1,3-Cyclohexadiene-1-carboxaldehyde, 2,6,6-trimethyl-	C10H14O	150.1	0.97	Not known
5	7.76	.alpha.-Cubebene	C15H24	204.2	1.33	5, alpha-reductase inhibitor,

						alpha-amylase inhibitor, alpha-glucosidase inhibitor, alpha-reductase inhibitor, HIF 1 alpha inhibitor, increase alpha-N-mannosidase activity, interleukin-1 alpha inhibitor, testosterone 5-alpha reductase inhibitor, TNF-alpha inhibitor
6	8.07	Copaene	C15H24	204.2	0.65	Not known
7	8.26	1H-Cyclopenta[1,3]cyclopropa[1,2]benzene, octahydro-7-methyl-3-methylene-4-(1-methylethyl)-, [3aS-(3a.alpha.,3b.beta.,4.beta.,7.alpha.,7aS*)]-	C15H24	204.2	0.68	Alpha Glucosidase inhibitor, 5 alpha reductase inhibitor, Alpha amylase inhibitor, HIF-1 alpha inhibitor, IkappaB alpha phosphorylation inhibitor, Interlukine-1-alpha inhibitor, Testosterone 5 alpha reductase inhibitor, 11HSD inhibitor, 12 Lipoxygenase inhibitor, 17 beta hydroxysteroid dehydrogenase inhibitor, 5 HETE inhibitor, 5 HT inhibitor, 5 Lipoxygenase inhibitor, 8 HETE inhibitor, ACE inhibitor, Acetyl co A carboxylase inhibitor
8	8.39	Longifolene	C15H24	204.2	1.39	Not known
9	8.58	Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trimethyl-4-vinyl	C15H24	204.2	0.76	Not known
10	9.50	cubedol	C15H26O	222.2	0.94	Not known
11	9.75	4-epi-cubedol	C15H26O	222.2	1.55	Decreases epinephrine production, epidermal stimulant
12	9.83	trans-calamenene	C15H22	202.2	0.59	Catechol O methyl transferase inhibitor, decreases glutamate oxaloacetate transaminase, Decreasesglutame pyruvate transaminase inhibitor, Glucosyl S transferase inhibitor, Glutathione S transferase inhibitor, Increase Glyoxalate transamination,Reverse transcriptase inhibitor
13	9.86	Naphthalene, 1,2,3,5,6,8a-hexahydro-4,7-dimethyl-1-(1- methylethyl)-, (1S-cis)-	C15H24	204.2	1.40	Not known

14	10.88	Humulane-1,6-dien-3-ol	C15H26O	222.2	0.57	It is a Oligosaccharide provider
15	11.02	1H-Cycloprop[e]azulen-7-ol, decahydro-1,1,7-trimethyl-4-methylene-, [1ar-(1a.alpha.,4a.alpha.,7.beta.,7a.beta.,7b.alpha.)]-	C15H24O	220.2	1.28	5, alpha-reductase inhibitor, alpha-amylase inhibitor, alpha-glucosidase inhibitor, alpha-reductase inhibitor, HIF 1 alpha inhibitor, increase alpha-N-mannosidase activity, interleukin-1 alpha inhibitor, testosterone 5-alpha reductase inhibitor TNF-alpha inhibitor
16	11.28	(-)-Globulol	C15H26O	222.2	0.62	Not known
17	12.17	Tridecanoic acid, 12-methyl-, methyl ester	C15H30O2	242.2	0.83	Catechol-O-methyl-Transferase Inhibitor, methyl Donar, Methyl Guanidine Inhibitor, Acidifier, Arachidonic acid inhibitor, Increase Aromatic Amino acid Decarboxylase activity
18	12.67	Tetradecanoic acid	C14H28O2	228.2	5.99	Acidifier, Arachidonic acid inhibitor, Increase Aromatic Amino acid Decarboxylase activity
19	13.58	Tricyclo[4.4.0.0(2,7)]dec-8-ene-3-methanol, .alpha.,.alpha.,6,8-tetramethyl-,stereoisomer	C15H24O	220.2	1.62	Not known
20	14.21	Hexadecanoic acid, methyl ester	C17H34O2	270.3	0.54	Catechol-O-methyl-Transferase Inhibitor, methyl Donar, Methyl Guanidine Inhibitor, Acidifier, Arachidonic acid inhibitor, Increase Aromatic Amino acid Decarboxylase activity
21	14.58	n-Hexadecanoic acid	C16H32O2	256.2	1.73	Catechol-O-methyl-Transferase Inhibitor, methyl Donar, Methyl Guanidine Inhibitor, Acidifier, Arachidonic acid inhibitor, Increases Aromatic Amino acid Decarboxylase activity
22	15.73	12,15-Octadecadienoic acid, methyl ester	C19H34O2	294.3	1.10	Catechol-O-methyl-Transferase Inhibitor, methyl Donar, Methyl Guanidine Inhibitor, Acidifier, Arachidonic acid inhibitor, Increases Aromatic Amino acid Decarboxylase activity

23	15.80	6-Octadecenoic acid, methyl ester, (Z)-	C19H36O2	296.3	0.82	Catechol-O-methyl-Transferase Inhibitor, methyl Donar, Methyl Guanidine Inhibitor, Acidifier, Arachidonic acid inhibitor, Increases Aromatic Amino acid Decarboxylase activity
24	16.13	9,12-Octadecadienoic acid (Z,Z)-	C18H32O2	280.2	2.84	Catechol-O-methyl-Transferase Inhibitor, methyl Donar, Methyl Guanidine Inhibitor, Acidifier, Arachidonic acid inhibitor, Increases Aromatic Amino acid Decarboxylase activity
25	16.19	9-Octadecenoic acid, (E)-	C18H34O2	282.3	2.12	Catechol-O-methyl-Transferase Inhibitor, methyl Donar, Methyl Guanidine Inhibitor, Acidifier, Arachidonic acid inhibitor, Increase sAromatic Amino acid Decarboxylase activity
26	17.47	Isobornyl propionate	C13H22O2	210.2	12.21	Not known
27	17.64	Methenolone	C20H30O2	302.2	0.54	Not known
28	18.14	i-Propyl 5,8,11,14,17-eicosapentaenoate	C23H36O2	344.3	1.29	Ionotrpoic, 11B-HSD inhibitor, 5 alpha reductase inhibitor, HIF1 alpha inhibitor, Alpha amylase inhibitor, IkappaB-alpha alpha phosphorylation inhibitor, Interlukine- 1 alpha inhibitor, Testosterone 5 alpha reductase inhibitor, 12 Lypoxygease inhibitor, 17 beta hydroxysteroid dehydrogenase inhibitor, 5 HETE inhibitor, 5 HT inhibitor, 8 HETE inhibitor, ACE inhibitor, Acetyl CoA carboxylase inhibitor
29	18.82	Abietic acid	C20H30O2	302.2	3.85	Acidifier, Arachidonic acid inhibitor, Increases Aromatic Amino acid Decarboxylase activity
30	21.58	(2,6,6-Trimethylcyclohex-1-enylmethanesulfonyl) benzene	C16H22O2S	278.1	0.66	Not known
31	22.15	Ethyl (1R,4S)-1,7,7-trimethylbicyclo[2.2.1]heptan-2-yl carbonate	C13H22O3	226.2	1.22	It helps in Free radical scavenging, RNA stimulant, selective serotonin reuptake inhibitor, suppresses HMG-CoA

						reductase activity, 5 alpha reductase inhibitor, Aldose reductase inhibitor, Angiotensin receptor blocker
32	23.31	2-Pentenoic acid, 3-methyl-5-(2,6,6-trimethyl-1-cyclohexenyl)	C15H24O2	236.2	0.75	Catechol-O-methyl-Transferase Inhibitor, methyl Donar, Methyl Guanidine Inhibitor, Acidifier, Arachidonic acid inhibitor, Increases Aromatic Amino acid Decarboxylase activity
33	24.38	.gamma.-Sitosterol	C29H50O	414.4	0.62	This is a PPAR-gamma antagonist
34	24.50	.beta.-Amyrin	C30H50O	426.4	4.97	17 beta hydroxysteroid dehydrogenase inhibitor, Antiamyloid beta, Anti TGF beta, Beta receptor agonist, Beta-adrenergic receptor blocker, beta blocker, beta galactosidase inhibitor, beta glucuronidase inhibitor, ER beta binder
35	24.60	.alpha.-Amyrin	C30H50O	426.4	0.60	5 alpha reductase inhibitor, alpha amylase inhibitor, alpha glucosidase inhibitor, Antibacterial, Antioxidant, Potential antiplatelet component, Hypoglycemic, Hypolipidemic, Sedative,Hepatoprotective

Qualitative Compound Report

Data File	200520016.D	**Sample Name**	Kachuradi Churnam
Sample Type		**Position**	28
Acq Method	GC Screening Method.M	**Acquired Time**	22-05-2020 AM 06:26:30
Comment			

User Chromatogram

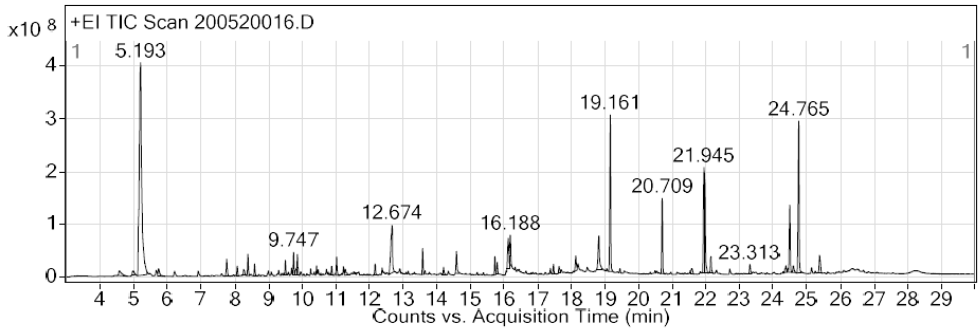

Figure 1.Indicates the GC MS profile of Kachuradi churnam.

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REVIEW ARTICLE

An Overview on Haemovigilance

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ABSTRACT

This review article briefly describes about the haemovigilance programme of India and the implementation of Haemovigilance on a National level as an Indian perspective. Haemovigilance mostly aims to assure the surveillance of blood transfusion, from blood collection, storage and further steps involved. Blood transfusion plays an important role in the improvement of health and safety of transfusion therapy. Nowadays most developed countries have implemented haemovigilance to monitor the adverse effect in blood transfusion. Haemovigilance is an organised system of monitoring, identifying, reporting, investigating and analysing adverse events and reactions pertinent to transfusion and manufacturing blood products. It is a risk monitoring system basic to the conventional practice of transfusion medicine, ultimate purpose is to improve the quality and assurance safety of transfusion. The goal of Haemovigilance programme of India is the part of the International Haemovigilance Network (IHN) which presently has 28 countries as its affiliate. It provides global forum for administering best practices and bench-marking of Haemovigilance data.

Keywords: Haemovigilance, Blood transfusion, Haemo-vigil, Donor- vigil

INTRODUCTION

Haemovigilance is an organised scheme of monitoring, identifying, reporting, investigating and analysing adverse events and reactions pertinent to transfusion and manufacturing blood products. Blood transfusion plays an

important role in the improvement of health and saves many lives, because there is no substitute for human blood(1). Haemovigilance, the term derived by amalgamation of Greek word 'haema' means blood and a Latin word, 'vigil' means watchful. The concept of haemovigilance first came into existence in France in 1990, almost with same ideas and vision of Pharmacovigilance(2). Initial work on haemovigilance was initiated in France in 1994 by creating a monitoring system 'Blood transfusion committee' and establishing a national haemovigilance system(3). Haemovigilance system is the programme which ensures the transfusion safety by monitoring every step of transfusion process from donor to recipient. The ultimate aim of haemovigilance system is improving the quality and safety of transfusion therapy(4). Hemovigilance has evolved from pharmacovigilance, which aims to collect and assess information related to medicinal products, most importantly adverse drug reactions in human beings. Pharmacovigilance in transfusion medicine deals with plasma derivatives: Clotting factor concentrates immunoglobulins, albumin, and other fractionated products. Hemovigilance, as the name suggests, is responsible for blood components: Whole blood, erythrocytes concentrates, thrombocytes concentrates, and fresh frozen plasma(5). Most of the countries like Denmark, Canada and Ireland have a voulantry reporting necessity. In this country Haemovigilance programs are connected to International Haemovigilance Network (IHN) which is presently have 28 members(6). International Haemovigilance Network (IHN) and International Society on Blood transfusion (ISBT), which was a major working committees of Haemovigilance program(7). According to this guideline, an adverse event is defined as any undesirable or unintended occurrence before, during or after transfusion of blood or its components that may lead to death or life threatening or disabling condition of patient or which results in, or prolongs, hospitalization or morbidity(3).

National Haemovigilance Programme of India

Hemovigilance Program of India was launched at the national level on December 10, 2012, as a fundamental component of the Pharmacovigilance Program of India (PvPI)(5). Indian Pharmacopoeia Commission in collaboration with National Institute of Biologicals, NOIDA, Uttar Pradesh has launched a haemovigilance programme of India(8). A centralized haemovigilance program to assure patient safety and to promote public health has been launched for the first time in 60 medical colleges in the first phase along with a well-structured program for monitoring adverse reactions associated with blood transfusion and blood product administration. In 2013 the number will be increased to the total of 90 medical colleges' enrolled for haemocovigilance programme(9). Software "Haemo-Vigil'' Programme has already enrolled 117 Medical College and Hospitals in India to collect and analyze the data pertaining to all over the country(8). HvPI is a member of International Haemovigilance Network (IHN). The targets of HvPI are grouped into three phases which are initiation phase, expansion & consolidation phase and expansion & maintenance phase. The initiation phase was focused on the development of systems and software development(1). Hemovigilance program has been launched to communicate findings to all key stakeholders and to create national and international linkages. The ultimate goal of this HvPI is to be a part of the IHN, which presently has 28 countries as its members and provide a global forum for sharing best practices and benchmark of hemovigilance data(6). Government of India with a primary objective to track adverse reactions/events and incidences associated with blood transfusion and blood product administration and to identify trends, recommend best practices and interventions required to improve patient care and safety(10).

Objectives of HvPI

To collect, combine and analyze the data of reactions associated with transfusion of blood and its components. To have statistical data for analyzing reactions associated with transfusion of blood and its components, blood and its components include whole blood, red blood cells, fresh frozen plasma, plasma derivatives, platelets, *etc.*

- Promote awareness among the healthcare professionals to participate in this programme.
- Set requirements to access tracking and alert notification on serious risks, adverse reactions, and events.
- Monitoring of an adverse event after the blood transfusion process is essential so as to take immediate action to save the life of the patient.

- To develop evidence based recommendations and assist the Central Drugs Standards Control Organization (CDSCO) in regulatory decision making regarding with transfusion safety
- To communicate pertinent information to the stakeholders.(1)(7)

Advantages of Haemovigilance

- Haemovigilance provide confidence for voluntary blood donors.
- Reduces the complications in the blood transfusion process.
- Haemovigilance systems can improve the safety of patient's health by exact prediction of current issues which affects the patient.
- It Provide evidence-based recommendations for the improvement of better policy changes
- Any applicable deficiencies can be detected on an initial basis state in blood transfusion service.
- It provides information about the main

Stratergies and Challenges for implementing Haemovigilance program

To determine the current issues and controversies associated with the Blood transfusion safety and to obtain the reports from the case studies where the patients affected severely due to the blood transfusion errors in various basis. Providing the right conclusion and recommendations in order to develop the emerging field of Haemovigilance. To insist their importance to the public health authorities and working committee members who are responsible for the organization of Blood transfusion process(7). There several problems exist at different levels, includes institutional, regional, national and international and these problems could not be solved(11). Implementing a haemovigilance system requires an effective and advanced schematic work, include Obtaining financial support for carrying out entire functions, as well as arranging a schematic framework for administrative setup for implementing the organization of the national haemovigilance system(2). Major challenges of implementing Haemovigilance Challenges will vary based on Country-specific guidelines(7).

Description of Software

The response and use of software depend on knowledge, integrity, and also truthfulness of patent, otherwise the data obtained could be misleading in interpretation. There are two softwares : Haemo-vigil and Donor- vigil software which is used for the sample tracking.(12)Haemovigil Software which covers the complete transfusion process by collecting blood and its components with obtained results and reports on a statistical data basis. Haemovigil Software is used to target the most error-prone part of the transfusion process. Mostly 70% of the errors are comes along with the process. National informatics centre was collected the errors.(7) Some important events in the development of this software are given in figure 2.(1)

HvPI – Aim and important definitions associated with transfusion

HvPI has been designed and developed to find out, collect, combine and examine the adverse reactions associated with transfusion of blood and its components with the aim of identifying the trends which suggesting suitable practices and interventions needed to improve the patient care and safety. To provide suggestions to the authorities to make the changes in policy for improving transfusion safety(1). The core group of the advisory committee has already formulated a document on transfusion reaction reporting the information which is used to improve the transfusion safety(10).

Objective for reporting adverse reactions in transfusion

Transfusion associated adverse reactions are broadly grouped in to two categories, infectious and non infectious. The noninfectious category is again classified in to acute and delayed type reactions(13). National reporting system can usefully be admired as a tool to advance public policy concerning patient safety. ADR Monitoring Centres which are medical colleges and institute or blood banks in India that are registered to Pharmacovigilance National co-ordinating center for reporting ADR occurred during blood transfusion(8).

CONCLUSION

Haemovigilance programme is an important part of quality management in blood transfusion chain. Hemovigilance system is a sensitive and effective programme which involves risk factors in case of monitoring, investigating and analyzing of blood transfusion and blood products to ensure safety and quality aspects of blood. The advice and information acquired from the haemovigilance and analyses facilitate corrective and preventive actions to be taken to minimize the potential risks associated with quality and safety in blood processing and transfusion for donors, patients and staff. Based on the recommendations and applicable solutions, the Implementation of Haemovigilance around the world in International, as well as a National basis, will become successful. World Health Organization (WHO) may help in developing an efficient system in developing countries. The well established haemovigilance systems of various countries have provided insight into various measures based on their data. Haemovigilance is thus a tool to improve the quality of the blood transfusion chain, primarily focusing on safety. The information gained from the haemovigilance facilitates corrective and preventive actions to minimize the potential risks associated with safety and quality in blood processing and transfusion to donors, patients and staff.

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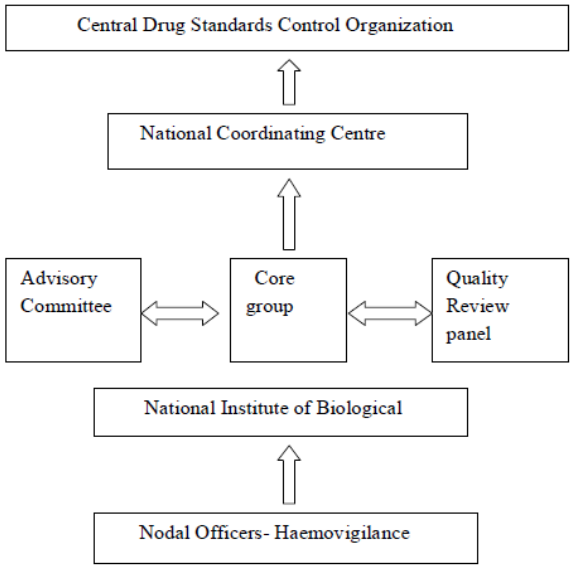

Fig 1: Organizational Structure of HvPI

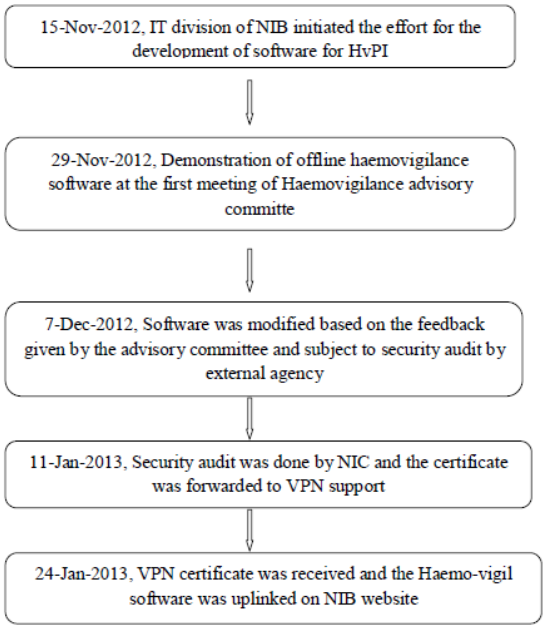

Fig 2: Important events in the development of this software

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RESEARCH ARTICLE

Wi-Fi Enabled Water Saving Irrigation System using Photon Particle

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ABSTRACT

In developing countries, the dynamic part in food production development is occupied by agriculture. For an effective agriculture, to ease the difficulty of water scarcity and lack of monsoons, way out is to implement an automatic irrigation system. The research proposed a smart irrigation system for water saving in agricultural field. This irrigation system consists of three modules such as sensor unit, information unit and application unit. The sensor unit consists of soil moisture sensor, humidity sensor and temperature sensor which are capable of sensing and share the collected information to the information unit. The measurement of soil moisture and temperature data provided by sensors is sent to the Photon particle, which comprises of microcontroller and Wi-Fi module. Based on the soil moisture level, the motor will be automatically switched ON when it is below the threshold value and OFF when it attains the threshold value. The motor is controlled by the relay through which the power is given to the motor. The information unit communicates the sensed value to the users through a smart phone app. A smart phone app has been created to display the actual time values and the reference values of the sensors. Thereby, Wi-Fi enabled irrigation system is facilitated to enrich the quality and quantity of farming yields by providing optimal amount of water at right time without manual intervention.

Keywords: Photon particle, Internet Irrigation, IoT, Wi-Fi Module

INTRODUCTION

Agriculture is the revenue source for most of the people in the agriculture economy based country. Agriculture field needs incredible quantity of water. Due to the lack of monsoons, scarcity of land water and unplanned practice of

water usage leads to the water resource shortage. This issue is also due to the water contamination by using pesticides, chemicals and some other artificial manure. In order to reduce the water scarceness, irrigation is to be employed in the agriculture field. Traditionally, the physically regulated method of irrigation is followed. In this method, manually the water pump is controlled at regular interval of time. When the absence of farmer, irrigation may consume more water (over irrigation) causes plant disease and sometimes delay in water supply (under irrigation) to the land causes crop dry off and leads to loss of production. To increase the production yield, the modernization of agricultural methodology is to be implemented. This research work develops a low cost programmed irrigation system to eradicate the over irrigation and under irrigation problem, reduction of labor cost and rise the production yield. The proposed irrigation system has a wireless network with sensor module of soil moisture, temperature sensors and humidity sensors. The transceiver handles the sensor information and transmits the data to the information unit. The sensor unit contains the data about the soil moisture, soil temperature and soil humidity. Photon particle controls the entire setup of the system and the Wi-Fi module is used to transmit and receive data. [1]

Literature Review

The objective of this system is to afford the smart irrigation for saving time, money and power. Automatic irrigation systems were implemented by using various devices like Arduino, ZigBee, ESP8266 Wi-Fi module, GSM, GPRS and smartphone. Jorge Sales et al., explains the GPRS communication between the wireless sensor network and internet. By using GPRS, automatic irrigation system is connected to the internet. Closed loop irrigation is used to optimize the water usage and save the resources. For reliable data transmission, used datagram protocol had implemented and transfers over GPRS. Two techniques such as byte stream and independent frame is used to transfer the data. The later technique gives the best result by involving in retransmission of non-acknowledged packets and support transmission of information [2]. Joaquin Gutierrez et al., describes the smart irrigation system by using smartphone. The smartphone captures and process the soil images to evaluate the area dryness and wetness. An android app is used for transmission of data to the gateway through a router node. The mobile app facilitates the smartphone Wi-Fi connection to transmit the estimation value for water pump control [3]. M. Usha Rani et al., presents an automatic irrigation system by using Grove moisture sensor. The water flow sensor sense the flow range and operating pressure based on the soil moisture level. By using web technology, the monitored data will be uploaded in the web portal. The updated information will be available on the webpage from where the user can get details about the moisture level and motor status [4].

Ibrahim Mat et al., illustrates the irrigation system in a greenhouse for precision agriculture. In greenhouse agriculture, temperature, humidity and soil moisture are monitored and the data collected from the sensors send to the remote server. Precision agriculture irrigation helps to improve the product quality and optimize water and fertilizer usage and maintains soil moisture [5]. Jia Uddin et al., design an automatic irrigation system by using microcontroller and solar power. To measure the environmental parameters various sensors are placed in the paddy field. Sensors sense the data and sent the information to the farmer through the mobile phone. Automatically motor will turn off when the sufficient amount of water is supplied [6]. Mansour et al., explains about the enhancement of the irrigation system using fuzzy logic controller. The fuzzy logic scheme supports decision making and increase the accuracy of the observed data [7]. Avinash Kumar Singh et al., targets to offer a cloud based automatic irrigation system to support the farmers. This system is composed of sensors, Ethernet shield and cloud connector which reduces the range problem through internet. The aim of this work is to modernize agriculture through modern engineering which supports water management. [8]

WI-FI Irrigation System using Photon Particle

The main goal of the project is to implement water saving smart irrigation system which monitors temperature and humidity value. The Soil Moisture is measured by using CS616 soil moisture sensor and humidity and temperature level is monitored by HS1100 sensor and DTH11 sensor respectively. The sensed moisture, temperature and humidity value are transmitted through the photon particle and it can be viewed in a smartphone. The working

model of Wi-Fi based water saving irrigation system using photon particle is shown in the Figure 1. Here the photon particle is initialized with suitable libraries. The sensors such as soil moisture, temperature and humidity sensors measures the moisture, temperature and humidity values respectively. The I/O line of the photon particle read the sensed data and stored. Depends on the soil moisture value, the ON /OFF of the motor is determined. If the value is less than threshold volumetric water control, the motor will be ON. Relay is used to drive the single phase AC motor which interface with I/O line of the photon particle. The information about the farm field can be viewed in the smart phone through the android app built in the mobile and the information is received from the Wi-Fi enabled photon particle. [9]

Hardware description

Particle photon: Particle photon is the hardware kit used in Internet of Things (IoT) applications. It has powerful STM32F205 120MHz based ARM Cortex M3 microcontroller with a Broadcom BCM43362 Wi-Fi chip and it has 1MB flash memory, 128 KB RAM memory, On-board RGB status LED, Soft AP setup and it is a open source design with Real-time operating System. The RGB LED on Photon board is used to deliver information about the mode the device is in by the color of the LED and its blinking pattern. The SETUP button is on the left and the RESET button is on the right is shown in Figure.2.

Soil Moisture Sensor: Soil moisture sensor estimates the volumetric water content by the properties like electrical resistance, dielectric constant and with the interaction of neutrons. Due to soil type, temperature and electric conductivity, the measurement may vary. Inserting a probe into the soil, a meter indicates the moisture content of the soil as dry, moist or wet for the plants.

Humidity sensor: Humidity sensor reports about the humidity and temperature. It works by sensing changes which alters electrical currents or air temperature.

Relay and Motor: Relays are used to control a circuit by an independent low power signal. Solid state relays uses semiconductor properties for control the circuits. Here it is used to drive motor which interface with the photon particle. The I/O line of the photon particle is high, the motor will be ON through relay. It helps to switch ON and OFF the motor much faster. The motor works based on relay and it converts electrical power into mechanical power.

SMPS: A switched mode power supply is a power supply used to transfer power from main supply (DC or AC source) to the DC loads. It supplies smaller power due to its smaller transformer and weight.

Software Description

The interfacing used for this work are stepper motor interfacing, wireless sensor circuit interfacing, LCD interfacing and serial communication used for downloading the hex code. Serial communication software is used for downloading hex code from photon particle. A cross compiler for compiling and linking the code written for photon particle. Smart measurement starts from the sensors inserted into the soil and the sensors uses the wireless technology to communicate with the phone or tablet. Smart monitoring system includes the sensors such as soil sensors, humidity and temperature sensors are set in a place and connected to the smart devices. To know the sensor measurement details, the user have to install the Thinkspeak monitor application. The user receives the messages and notifications all the time. It also provides the details regarding water required for the crop. Thinkspeak is an open source platform for the development of IoT applications. It enables the services like collection of real time data, analyses the data by means of charts.

RESULTS AND DISCUSSION

The Wi-Fi enabled irrigation system is designed and implemented in our laboratory. Here the farm field setup is created with the moisture field and non-moisture field. The designed irrigation system model is tested with the farm

field. The designed irrigation system model is shown in the Figure 3. The records of automated irrigation system in the webpage displays the water level, motor status and live temperature. Figure 4 represents the hourly measurement of humidity and temperature values on a day observed from the humidity and temperature sensor. Soil Moisture ranges from 10% to 45% volumetric water content. Soil Moisture level is higher at the time of watering and after watering. The value is observed two inches below the soil surface where the soil is wetter compared to the top surface, sometimes the soil felt drier but the readings of the moisture content as wet. Smart irrigation system make available for effective agricultural management by providing price adequate water supply. Wi-Fi enabled irrigation system framework permits it to extend up for larger greenhouses or open farms. As the need to conserve water resources increases, water protection practices for irrigation system should be incredible and moderate. Precision limiting in order to upgrade the irrigation system the excess of water usage, effectiveness while extend crop yields. The best method for deciding water solicitations of harvests depends on the continuous controlling of soil dampness. The observed data from the sensors such as soil moisture, temperature and humidity sensors is viewed in the smart phone which is processed through the Wi-Fi enabled photon particle used in the system is shown in Figure 5. The users will be updated with their farm details through the smart phone. Photon particle frequently sends the messages.

CONCLUSION

The designed irrigation system reduces the manual work such as valve opening, checking soil moistures and motor on and off. Here Photon particle communicates with user about sensor data and water supply. Thus the system monitors water supply between various areas, flow and leakage of water. An automated irrigation system supports water management for greenhouse farms and other yielding fields. The automation era helps the farmers to manage their resources efficiently and economically to improve the crop production.

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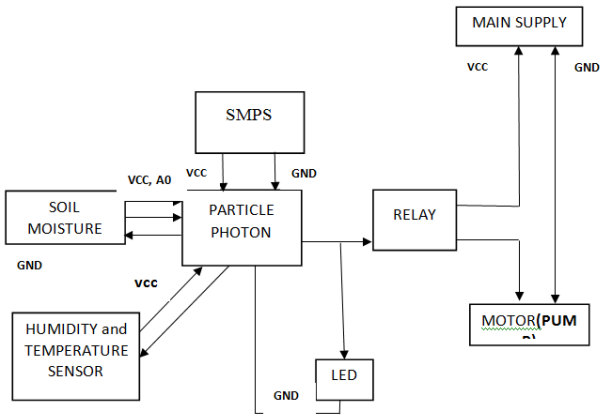

Figure 1: Block diagram of Wi-Fi irrigation system

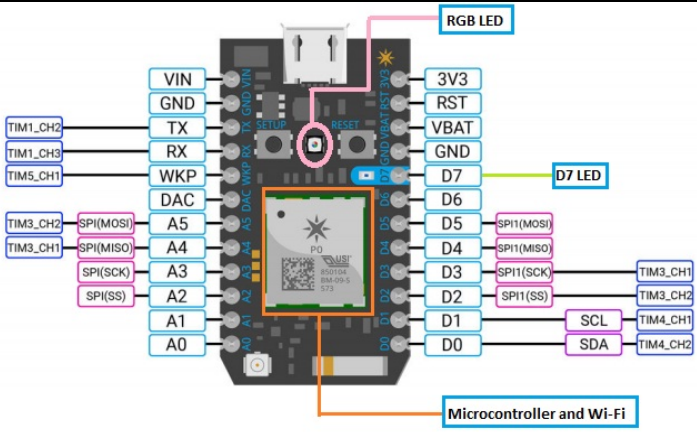

Figure 2: Photon Particle

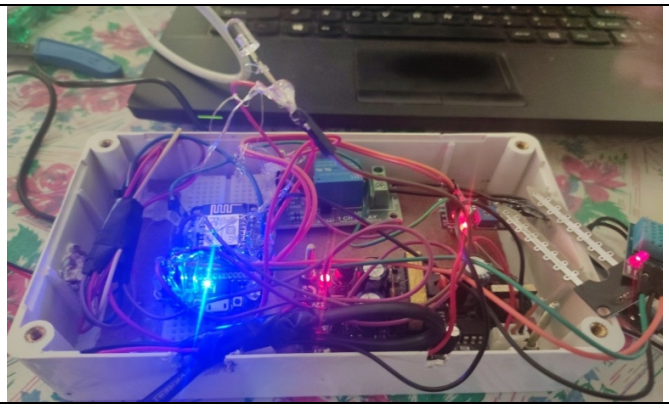

Figure 3: Irrigation system using Photon Particle

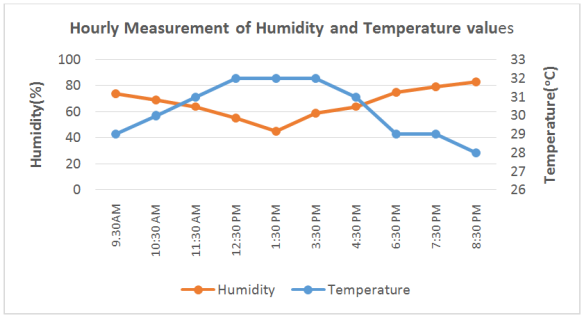

Figure 4: Hourly Measurement of Humidity and Temperature values

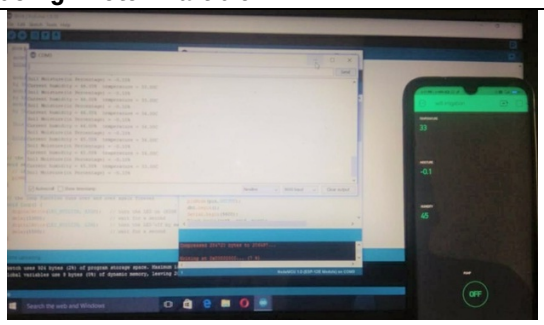

Figure 5: Observed sensor data in the Smart Phone

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RESEARCH ARTICLE

Evaluate the Practice of Household Waste Management among Mothers of Primary School Children in View to Develop Pamphlet

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ABSTRACT

All over the World disposal of household waste is one of the major Environmental Problem. Lack of Knowledge and Practice regarding the household waste management among householders causes many infectious and communicable diseases like diarrhea, cholera etc. The ultimate goal of domestic Waste management system is to provide hygienic, economic, and efficient collection, transportation, treatment and disposal of waste without polluting the atmosphere, soil or water resources. The present study was aimed to evaluate the practice of household waste management among mothers of primary school children. A descriptive study was carried out among 100 mothers of primary school children in Karaikal. The mothers who met the inclusion criteria were selected by Non Probability convenience sampling technique for the study. The data were collected from the mothers of Primary school children by using self structured checklist about their routine practices on disposal of household waste. The study revealed that majority 43 % mothers have poor practice, 38 % mothers have average practice and only 19 % mothers have good practice in disposal of household waste management. The significant association was found between practices of waste disposal management and age of the mothers and no association was found with other demographic variables such as age, number of members in house and type of family. The study concluded that Mothers of primary school children had poor practice on disposal of household waste management. Researcher prepared and distributed the pamphlet regarding awareness and practice on safe disposal of house hold wastes because Proper disposal method saves the human being from the illness and earth from the infectious diseases and global warming.

Keywords: Assess Practice, House hold waste management, and Mothers of Primary school children.

INTRODUCTION

Proper waste disposal management is essential to protect the environment. Improper disposal of wastes pollute the soli, air, water and it dangers the living organisms not only the human beings and also the plants, birds, animals and etc. The environmental sanitation promotes health of the community by providing clean environment and breaking the cycle of disease. Quality of human's life is influenced by clean environment. Awareness and education is very necessary about waste disposal among householders [1]. Householders must have knowledge on sources of domestic waste and its disposal method. Waste materials that are generated by activities of humans and animals and are discarded which means useless. Waste disposal mean removing and destroying or storing the damaged, used or unwanted materials included domestic, agricultural, commercial and packing waste. The Disposal methods included dumping, burial and landfill sites should choose any on the nature of waste [2]. House hold wastes are in different kinds such as waste generated from kitchen, garden waste and used leather, rubber, glass, plastics, electronic items, etc. Waste water from the kitchen, bathroom and laundry is named as "Grey water". It is also termed as sullage. In that some of the wastes affect the balance of environmental or ecological. Some hazardous wastes are batteries, cooking oil, pesticides and fertilizers etc [3,4,5].

Process of collecting, transporting, processing or disposing, managing and monitoring of wastes is known as waste management. Activity and the process are focused to decrease the effect on health, and environment. Segregate the dry and wet wastes in separate and accumulate in closed dustbin [6,7]. Sanitation is an effective barrier of environmental contamination and the disease transmission. Householders with inadequate awareness regarding domestic waste disposal have poor attitude and practice towards waste disposal in their homes. Lack of proper environmental sanitation system and poor environmental hygiene practices can lead to deterioration of community health [8,9]. So researcher selected this concept to evaluate the practice on household waste management and make Awareness through pamphlets on disposal of household waste management. It is necessary to improve their awareness regarding correct disposal methods and it will be reflected in their practice.

STATEMENT OF THE PROBLEM

Evaluate the Practice of Household Waste Management among Mothers of Primary School Children in View to Develop Pamphlet

OBJECTIVES OF THE STUDY

- To evaluate the practice of household waste management among mothers of primary school children
- To find out the association between practice of household waste management among mothers of primary school children with their selected demographic variables
- To develop and distribute the pamphlet on practice of household waste management

MATERIAL AND METHODS

A descriptive study was carried out among 100 mothers of primary school children in Karaikal. The mothers who met the inclusion criteria were selected by Non Probability convenience sampling technique for the study. The data were collected from the mothers of Primary school children by using demographic proforma and self structured checklist about their routine practices on disposal of household waste. The check list consisted of 15 items related to the method of household waste disposal. It has 3 options like always, sometimes and never. The maximum score was 30 and categorized the level of practice as poor, average and good. The reliability of the tool was tested by Cronbach's alpha method and the r was =0.78.The informed consent had obtained from the mothers of primary school children.

RESULTS

Fig.1. Distribution of the mothers of primary school children according to their level of practice on disposal of household waste management. Table.1. Mean, sd and mean percentage on practice score of domestic waste management among mothers of primary school children

OTHER MAJOR FINDINGS OF THE PRESENT STUDY

77% of the mothers were thinking that proper waste disposal is important. 65 % of the mothers were expressed that the streets should be clean and free of waste. Regarding the Segregation of biodegradable waste from other waste the least 35% of mothers were practiced separation of wet and dry , most of them were (50%) not practiced the same. 67 % of the mothers were Burn plastic waste and 25 % of them never practiced. 68 % of the mothers were not used food waste for composting and only 23 % of them preparing compost by using the food waste. About throw waste on roadside and near the houses 63 % of the mothers were sometimes practiced and 37% never did it. With respect the emptying the waste container regularly to the public bin 65% of mothers sometimes emptied and remaining were thrown in empty field or burn it. The greater percentages 60% of the mothers were reusing the old glass bottles and 26% of them never used it. Majority 82 % of the mothers were sold old books and magazines. 56% of the mothers were washing and reusing the bag made by cloth and 17 % of them never used it. Most of the mothers (73%) reusing the plastic mineral water bottle for any one purpose and only 8 % of them never used it. In the present study also revealed that 69 % of the mothers were using plastic bag for collecting wastes, 52 % of the mothers were accepted that the best way of handling paper waste is recycling method and 43 % of the mothers were using covered container for waste collection. The significant association was found between practices of waste disposal management and age of the mothers and no association was found with other demographic variables.

DISCUSSION

The present study result showed that majority of mothers had poor practice in disposal of household waste management. The significant association was found between practices of waste disposal management only with age of the mothers. So this study evaluated and recommended that the mothers of primary school children need awareness and information. The Investigator prepared and issued the pamphlet regarding Household waste disposal management. Author was conducted cross sectional study among the households of Kuttar and Manjanadi villages and a sample of 120 households were studied. Majority had a good knowledge and positive attitude regarding household waste disposal but their practice was unsatisfactory as 78 households disposed the household wastes by just throwing away outside the house [10].

Similar type of cross-sectional study was carried out in rural area among 100 household peoples. They had good Knowledge regarding waste disposal. In spite of good knowledge, the respondents had poor Practices regarding waste disposal due to lack of awareness, unavailability of public dustbins [11]. Abdikadir Ahmed Omaret al., also supported that community people had good level of knowledge, positive attitude but their practice towards solid waste management was poor [12].

Another one descriptive study was conducted among women (210) residing in the village at Pondicherry in the age group of 18–55 years. The study result revealed that was knowledge level of the rural women regarding disposal of waste was inadequate as mean score was less than 50% of the total score and they had inappropriate practice of waste disposal [13]. One more study supported for need of pamphlet preparation and distribution. It was a cross sectional descriptive study samples of 160 women were selected by using non probability convenient sampling technique at Poola street urban area of Tirupati. The results identified that out of 160 women 80 (50%) had a moderate knowledge, 43 (26.9%) had inadequate knowledge, 37 (23%) had adequate knowledge. Found significant

association between the domestic waste management knowledge selected demographic variables, like education and occupation [14]. Ali Almasi et al., survey the knowledge, attitude and practice among 1750 females at Kermanshah city in Iran. The Authors are recommended that to improve the practice of householders by improving their knowledge. So planned to take effective steps for promoting the environment by safe disposal of wastes [15].

CONCLUSION

The study concluded and suggested that improvement in the environmental and personal hygiene practices of the mothers can contribute largely in reducing the prevalence of many diseases among children and their family members. Improvement in the basic facilities like provision for toilets and disposal of household waste will automatically contribute to improve the environmental hygiene practices.

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No conflicts of interest

Ethical Clearance
Taken from Institutional Research Committee

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Table.1. Mean, Sd and mean percentage on practice score of domestic waste management among mothers of primary school children

AREA	MAX.SCORE	MEAN	SD	MEAN PERCENTAGE
Practice of Household Waste Management	30	18.96	4.77	63.2%

Table.2. Association between practice of household waste management among mothers of primary school children with their selected demographic variables n=100

Demographic Variables	Practice on Household waste management						Chi square
	Good		Average		poor		
	F	%	F	%	F	%	
1.Age in years							
a) 21-25 YRS	6	6%	12	12%	9	9%	X^2=1.964 df=3 NS
b) 26-30 YRS	4	4%	11	11%	12	12%	
c) 31-35 YRS	5	5%	8	8%	12	12%	
d) <36 YRS	4	4%	7	7%	10	10%	
2.Education							
a) Degree	9	9%	27	27%	12	12%	X^2=17.58 df=3 **S***
b) Diploma	6	6%	5	5%	11	11%	
c) Higher Secondary	3	3%	3	3%	12	12%	
d) High school	1	1%	3	3%	8	8%	
3. Type of Family							X^2=2.90 df=1 NS
a) Nuclear	10	10%	18	18%	14	14%	
b) Joint	9	9%	20	20%	29	29%	
4) Source of Information							
a) Health Personnel	7	7%	13	13%	18	18%	X^2=0.35 df =2 NS
b) Mass media	5	5%	11	11%	13	13%	
c) Relatives and Friends	7	7%	14	14%	22	22%	

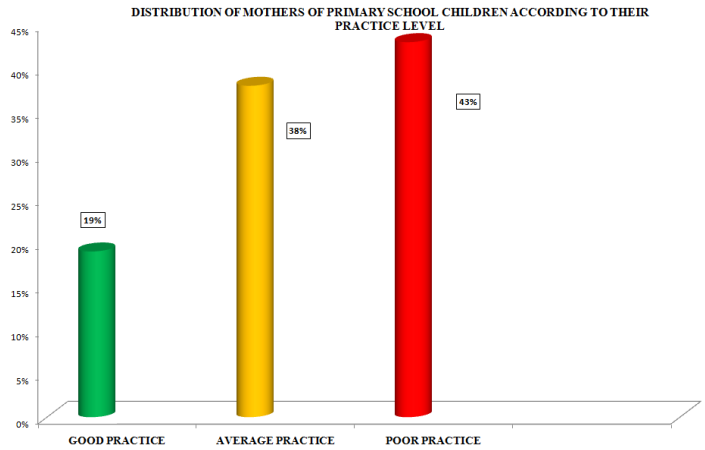

Fig.1. Distribution of the mothers of primary school children according to their level of practice on disposal of household waste management

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RESEARCH ARTICLE

Acute and Subacute Toxicity Studies of Ethanolic Root Extracts of *Picrorhiza kurroa* Royle ex Benth.

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ABSTRACT

Picrorhiza kurroa Royle ex Benth is one of the most important medicinal plants, commonly used in traditional medicinal systems. It is commonly called "Kutki" or "Kurro" and 'Indian gentian'. *It* is a well-known herb in Ayurvedic medicine. The present study was carried out to evaluate the safety of an ethanolic extract of roots of *Picrorhiza kurroa*. The acute and subacute toxicity studies were performed as per OECD guidelines (Organisation for Economic Co-operation and Development) – Guidelines 423 and 407. For the acute toxicity study, the female mice were treated with a single oral dose of ethanolic extracts of roots of *Picrorhiza kurroa* at 5,50,300 & 2000 mg /kg and observed for general toxicity and mortality for 14days. In subacute studies, both male and female rats were treated with 100,200 &400mg/kg orally for 28days continuously. The animals were observed weekly for any changes in general behaviour, body weights, food intake, water intake, and signs of morbidity and mortality. The results of the present study demonstrated that the oral administration of this extract does not show any toxicity in both acute and subacute toxicity studies. Hence, it was concluded that the ethanolic root extracts of *Picrorhiza kurroa* were safer and non -toxic to rats and further chronic studies are required to confirm its therapeutic efficacy in animals and humans.

Keywords: *Picrorhiza kurroa*, Acute toxicity, Sub-acute toxicity, Bio-chemical parameters, Haematological parameters.

INTRODUCTION

Herbals are still used widely by world population, because of better compatibility with the human body and lesser side effects [1]. Therefore, world has now turned its attention to natural products. *Picrorhiza kurroa* Royle ex Benth. (Scrophulariaceae), is a small perennial herb found mainly in the Himalayan region growing at an elevation of 3,000-5,000 m[2,3]. The leaves of the plant are flat, oval and sharply serrated. The leaf, bark and the underground parts of the plant, mainly rhizomes are widely used in the traditional Indian systems of medicine (Ayurved) since ancient times. *P. kurroa* is traditionally used to treat disorders of the liver, upper respiratory tract, fevers, dyspepsia, chronic diarrhoea, scorpion sting and cancer [4]. The DNA protective ability of the plant has been reported [5]. Although it shows antioxidant, anti-inflammatory and immunomodulatory activities, it is most valued for its hepatoprotective effect. *P. kurroa* rhizomes are widely used against indigestion problems since ancient times due to improper digestive secretions [6]. Many studies report that numerous active molecules were derived from plant products. Due to their diverse medicinal properties, it has created the belief that all plant products are safe [7]. Despite these studies and the widespread use of this plant in traditional medicine, no works on the toxicological profile of extract from leaves have been reported. Hence, a systematic study of medicinal plants for potential toxicity is a necessary step for the evaluation of their therapeutic effect Thus, this study aims to evaluate the toxicological profile of the ethanolic root extracts of *Picrorhiza kurroa*

MATERIALS AND METHODS

Plant material

The dried root powder *Picrorhiza kurroa* was obtained from Herbo Nutra, Uttar Pradesh, India, in the month of August 2021 was used for the study.

Preparation of extracts

About 500 g of dried root powder was subjected to continuous hot percolation with different solvents of increasing order of polarity such as pet ether, chloroform, acetone, ethanol, and aqueous [8]. The extracts were dried under the rotary evaporator and then tested for various phytochemical constituents like alkaloids, flavonoids, glycosides, phenols, saponins, sterols, tannins, proteins, and carbohydrates.

Animals

Healthy adult female Swiss albino mice and Wistar rats were used for the acute and subacute toxicity studies respectively. The animals were procured from CPCSEA listed suppliers of Srivenkateshwara Enterprises, Bangalore, India. Animals should be nulliparous and non-pregnant. The animals were kept in well-ventilated polypropylene cages at 12h light and 12 h dark schedule at 25°C and 55–65% humidity levels. The rats had been given a normal diet of pellets and free access to water. Each animal, at the commencement of the experiment, should be between 8 and 12 weeks old.

Preparation of animal

Healthy animals were randomly selected for the study and kept in their cages for at least 1week prior to dosing to allow for acclimatization to the laboratory conditions. Before each test, the animals were fasted for at least 12h; the experimental protocols were subjected to the scrutinization of the Institutional Animals Ethical Committee and were cleared by the same. All experiments were performed during the morning according to CPCSEA guidelines for the care of laboratory animals and the ethical guideline for investigations of experimental pain in conscious animals. The standard orogastric cannula was used for oral drug administration in experimental animals.

Toxicity Studies

Acute and subacute toxicity studies were performed as per OECD (Organisation forEconomic Co-operation and Development) – Guidelines 423 and 407[9-11].

Acute oral toxicity studies: The acute toxicity studies were performed as per OECD guidelines 423. A total of 12 mice weighing between 25-30g were randomly divided into four groups of 3mice each. Animals were fasted prior to dosing (food but not water was withheld over-night). Following the period of fasting, the bodyweight of the animals was measured and the ethanolic root extracts of *Picrorhiza kurroa* was administered orally to each group at single doses of 5, 50,300, and 2000 mg/kg, respectively. The control groups received the same volume of distilled water. All the animals were individually observed periodically during the first 24h after administering the extracts and then once a day for 14 days. All the animals were then allowed free access to food and water and observed for signs of acute toxicity. It includes changes in body weight, food and water intake, skin and fur, eyes and mucous membranes, respiratory and circulatory systems, autonomic and central nervous systems, somatomotor activity, and behaviour pattern. The number of deaths within this period was recorded. The urine analysis was performed to investigate any abnormalities in the excretion pattern after the exposure to the test drug for 14 days.

Subacute toxicity studies: The subacute toxicity studies were performed as per OECD guidelines 407. Rats weighing between 150-170g were divided into 3 groups of 10 rats each (5 male+5 female). All the animals were fasted over-night and after fasting, the bodyweight of the animals was measured. The ethanolic root extracts of *Picrorhiza kurroa* (ERPK) at the doses of 100,200 and 400 mg/kg was administered orally to each group respectively. The control groups were treated with the same volume of distilled water. All the animals were individually observed periodically during the first 24h after administering the extracts and then once a day for 28 days. During the 28days study, the body weights of all groups were measured once a week. Animals were also visually observed for mortality, changes in behavioural patterns, changes in physical appearance, and symptoms of illness.

Bodyweight: The individual weights of animals were determined shortly before the test substance was administered and at least weekly thereafter. Weight changes were calculated and recorded. At the end of the test surviving animals were again weighed.

Food and water intake: The food and water intake of each animal of both control and test groups was measured once per week throughout the study.

Urine analysis: The urine analysis was performed to investigate any abnormalities in the excretion pattern after the exposure with the test drug for 28 days. On the 28th day, the animals were anesthetized with ether and the blood samples were collected by cardiac puncture for hematological and biochemical studies. After euthanasia, all the animals were sacrificed and the vital organs were removed. The weight of the organs was measured and subjected to necropsy and histopathological examination.

Statistical Analysis

The results were expressed as the mean ± SEM and analysed statistically by one-way ANOVA followed by Dunnett's t-test by using SPSS version 16. $P < 0.05$ compared to control was considered to be statistically significant.

RESULTS AND DISCUSSION

The purpose of this research is to give scientific validation to the plants by collect and extract plant materials and then to screen them for potential phytochemical and Toxicological aspects. several pharmacological studies have been reported with the leaves of this plant, there is no experimental evidence on its toxicity studies. Hence, the current research work focused on the evaluation of phytochemical and toxic effects of ethanolic root extracts of *Picrorhiza kurroa*.

Phytochemical screening: The dried root powder of *Picrorhiza kurroa* was obtained from Herbo Nutra, Uttar Pradesh, India. The active principles present in the roots were extracted by a continuous hot percolation method

using various solvents and aqueous extract by cold maceration method. The active principles were identified by chemical tests, which showed the presence of various active principles such as Alkaloids, carbohydrates, gums and mucilages, phenolic compounds, proteins, and amino acids, flavonoids, phytosterols, tannins, and saponins.

Acute toxicity studies: Acute toxicity studies are performed to determine the short-term adverse effects of the drug when administered in a single dose orally. It also indicates the safety of the drug in-vivo. Acute toxicity study is generally carried out for the determination of LD50 value in experimental animals. The LD50 determination was done in mice as per OECD guidelines 423 and LD50 of the ethanolic root extracts of *Picrorhiza kurroa* was found to be 2000 mg/kg and the ED50 values were 200 mg/kg, respectively.

Subacute toxicity studies: During the 28days study, there were no significant changes in the body weight, food, and water intake in all test groups animals were observed when compared to the control group. The body weight and daily food and water intake were not altered by the treatment with the test drug at various dose levels (low, medium, and high). The consequence of urine analysis does not show any abnormalities in the excretion pattern. The organs isolated from various groups did not reveal any abnormalities on gross examination. The weights of the important organs were listed in Table No.1 No statistically significant differences were observed in the weight of the liver, kidney, and heart, of all test groups when compared to the control group. At the end of the study period, no statistically significant differences were seen in the mean haemoglobin content, WBC, RBC, and differential cell counts of all test groups, when compared to the control group, as shown in table no.2. At the end of the study period, no statistically significant differences were seen in the mean biochemical parameters were depicted in table no.3.

The histopathological studies with liver, stomach, spleen, kidney, heart, and lungs did not reveal any pathological changes and they were found to be normal as shown in Fig no.1-6. There were no significant changes in any liver function parameters, such as SGOT, SGPT, and ALP compared to the control. The normal levels of blood urea and serum creatinine indicate that the extracts did not interfere with renal function and that renal integrity was preserved [12]. Several researchers have reported that plant drugs are safe and effective in the treatment of incurable diseases [13]. The present findings suggest that the tested extracts are non-toxic since no marked changes in haematological, biochemical, and histopathological parameters were observed.

DISCUSSION

Natural products play a major role in medicine because of their minimal side effects. Despite these, there is still a lack of scientific validation regarding the toxicological aspects of natural compounds. Hence, Scientific knowledge of toxicity studies is much needed. This will help us to identify the safe dose levels of the drug and also the therapeutic index of drugs [14]. In the present study, phytochemical screening of the ethanolic root extracts of *Picrorhiza kurroa* showed the presence of various active principles such as Alkaloids, carbohydrates, gums, and mucilages, phenolic compounds, proteins, and amino acids, flavonoids, phytosterols, tannins, and saponins. In acute toxicity studies, the animals showed no significant changes in behaviour, breathing, cutaneous effects, sensory nervous system responses, or gastrointestinal effects during the observation period. No mortality or any toxic reaction was recorded in any of the four groups. Hence, it was safe up to 2000mg/kg.

In subacute toxicity studies, the treatment of ethanolic root extracts of *Picrorhiza kurroa* showed no significant changes in the weight of the body and organs. All the animals showed a gradual rise in body weight without much difference between both control and ERPK treated groups. The haematological parameters showed that the extract was not toxic to RBC and not altered its production and platelets. The hemopoietic pathway is one of the most vulnerable sites for toxic compounds and is a major physiological and pathological status measure in humans and animals [15]. Similarly, no changes were observed with WBC count and other factors. In addition, most of the biochemical parameters were not also altered by the ERPK treatment. It maintained the normal levels of liver

enzymes, glucose, creatinine levels, which indicates the normal functioning of the liver and kidney. Thus, it also indicates that 28days of treatment does not alter the physiology of the liver, kidney, and metabolism of animals. The above results were further confirmed by the histopathological studies of the vital organs.

CONCLUSION

In conclusion, the oral administration of ERPK at the doses of 5,50,300,2000 mg/kg for a period of 14 days did not produce any short-term toxicological effects. Further, the oral administration of ERPK at the doses of 100, 200, and 400 mg/kg for a period of 28 days was found to be safe in both male and female rats. It didn't show any severe ERPK treatment-related toxicity. In the future, detailed chronic studies are essential to confirm the safety of this plant.

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Table No 1: Weight of isolated organs of rats after 28days exposure to test and control groups

S.No	Group	Treatment	Dose mg/kg	Liver (g)	Kidney (g)	Heart (g)
1	I	Control	-	7.300±0.052	1.100±0.037	0.555±0.006
2	II	ERPK	100	7.320±0.093 ns	0.992±0.035 ns	0.558±0.004 ns
3	III	ERPK	200	7.217±0.048 ns	1.020±0.009 ns	0.588±0.006 ns
4	IV	ERPK	400	7.267±0.049 ns	1.027±0.006 ns	0.602±0.006 ns

Values were expressed as Mean ± SEM of 6 rats in each group.

The differences in mean weight of organs in extract treated groups were not significantly different from control group at the end of study (28 days).

Table No 2: Effect of ethanolic root extracts of *Picrorhiza kurroa* on haematological parameters in sub-acute toxicity studies.

Group	Treatment	Dose mg/kg	Hb (g/dl)	RBC (million/mm³)	WBC (1000/mm³)	Differential count				
						Neutrophils %	Eosinophils%	Basophils%	Lymphocytes%	Monocytes %
I	Control	-	13.17±0.31	9.32±0.21	10.33±0.50	26.33±0.33	2.73±0.08	0.17±0.005	76.33±0.49	2.67±0.21
II	ERPK	100	12.83±0.31 ns	9.52±0.25 ns	9.50±0.43 ns	25.00±0.37 ns	2.10±0.10 ns	0.17±0.006 ns	76.50±0.56 ns	3.83±0.31 ns
III	ERPK	200	13.50±0.43 ns	9.00±0.37 ns	9.67±0.49 ns	25.50±0.22 ns	2.40±0.06 ns	0.17±0.006 ns	74.33±0.42 ns	3.17±0.31 ns
IV	ERPK	400	13.33±0.42 ns	9.50±0.22 ns	9.33±0.42 ns	24.17±0.31 ns	2.67±0.10 ns	0.18±0.007 ns	78.00±0.63 ns	3.83±0.12 ns

Values were expressed as Mean ± SEM of 6 rats in each group. The mean values observed in Hb, RBC, WBC and Differential cell count of extract treated groups were not significantly different from control group at the end of study (28 days).

Table No 3: Effect of ethanolic root extracts of *Picrorhiza kurroa* on biochemical parameters in sub-acute toxicity studies.

Group	Treatment	Dose (mg/kg)	SGOT (U/L)	SGPT (U/L)	ALP (U/L)	Total Protein(g/dl)	Total cholesterol (mg/dl)	Total bilirubin (mg/dl)
I	Control	-	191.83±1.28	80.33±0.67	230.50±0.56	7.23±0.03	121.33±0.42	0.50±0.004
II	ERPK	100	190.67±0.67 ns	80.00±0.58 ns	232.17±0.48 ns	6.81±0.05 ns	122.83±0.48 ns	0.43±0.021 ns
III	ERPK	200	188.00±0.37 ns	81.17±0.31 ns	233.83±0.48 ns	6.88±0.03 ns	120.17±0.48 ns	0.42±0.009 ns
IV	ERPK	400	191.33±0.49 ns	82.50±0.43 ns	230.83±0.48 ns	7.29±0.02 ns	120.00±0.58 ns	0.42±0.019 ns

Values were expressed as Mean ± SEM of 6 rats in each group.

The mean values observed in biochemical parameters of extract treated groups were not significantly different from control group at the end of study (28 days).

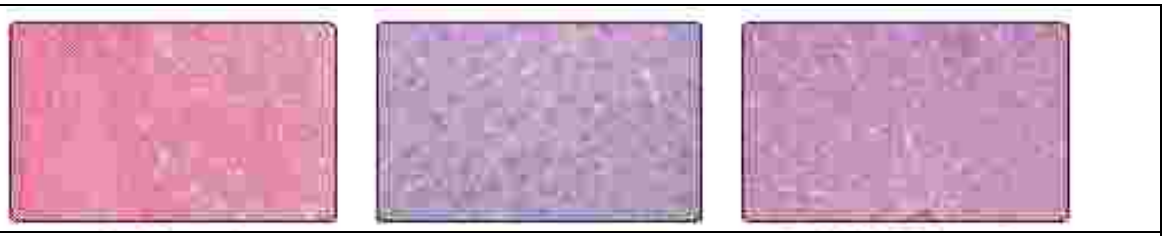

Fig No 1: Effects of ethanolic root extracts of *Picrorhiza kurroa* on liver in sub-acute toxicity.

Fig No 2: Effects of ethanolic root extracts of *Picrorhiza kurroa* on stomach in sub-acute toxicity.

Fig No 3: Effects of ethanolic root extracts of *Picrorhiza kurroa* on spleen in sub-acute toxicity.

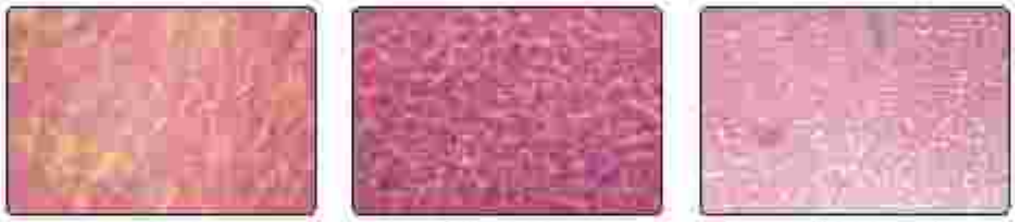

Fig No 4: Effects of ethanolic root extracts of *Picrorhiza kurroa* on kidneys in sub-acute toxicity.

Fig No 5: Effects of ethanolic root extracts of *Picrorhiza kurroa* on heart in sub-acute toxicity.

Fig No 6: Effects of ethanolic root extracts of *Picrorhiza kurroa* on lungs in sub-acute toxicity.

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RESEARCH ARTICLE

Computation of Option Greeks using Extended Normal Distribution

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ABSTRACT

In the nobel prize winning Black-Scholes option pricing model, underlying asset returns supposed to follow the Gaussian distribution with zero skewness. However, later from the market data of various stocks, it is observed that the returns exhibit some non-zero skewness. This makes market option price differ from the theoretical Black-Scholes option price. In this regard, some authors have proposed a non-gaussian option price using the extended normal distribution. However, this paper deals with the computation of the price sensitivities or option Greeks which are very essential for characterizing the corresponding option subject to various factor like stock price, interest rate, underlying stock volatility and time to maturity. This paper provides closed form expressions for most frequently observed Greeks under the extended normal distribution.

Keywords: risk-neutral mesure; option price; skewness; option Greeks.

INTRODUCTION

Traditionally the famous Black-Scholes option pricing model assumes normal distribution of the given asset returns (cf. [1]). But empirically, it has been observed that the probability density function (pdf) of returns possesses non-zero skewness and kurtosis as depicted by [2, 3] and others. This results in the deviation of market option price from the theoretical option price given by Black-Scholes. A number of assumptions of the famous Black-Scholes option pricing model are not followed in real life as noted by [4]. The non-Gaussian nature of the asset returns, volatility smile from implied volatility have been observed in financial market (cf. [4] and others). This motivates authors [5, 6] to propose different option pricing models satisfying aforementioned observed properties of the asset price. In this context authors namely, [7, 8, 9] and others have managed to propose a new option pricing model under stochastic jumps. However these models are not always acceptable as market becomes incomplete due to the presence of various stochastic components. Some authors [10, 11, 12]have also used higher moments of the corresponding stock returns to provide different option pricing models. It has also been noticed that, different assets are getting

influenced by various information, news and hence exhibit different properties which cannot be statistically observable. These types of properties across various stocks are very common which is termed as stylized facts [13]. Volume correlation, volatility clustering, leverage effects, heavy tails are some frequently observed stylized facts in financial time series [13]. Various authors [14, 15] have observed the heavy tails of the underlying returns distribution through power-law. Such type of behavior of the returns distribution gives rise to extended normal distribution. This particular distribution is subject to different values of kurtosis and skewness [4]. Ki et al. [4] have defined the extended normal distribution as a linear combination of two Gaussian distribution functions. Thereafter, it is necessary to derive the option price under the said returns distribution. Thus, Ki et al. [4] have managed to provide the European option price under risk-neutral measure and satisfying the moment restriction condition. They have also examined the validation of the proposed pricing model with the empirical KOSPI 2000 data sets. However, this said paper does not deal with the factors associated with option price such as stock price, time left for the option maturity, interest rate, volatility.

In this paper, we address some of the issues associated with the option price and risks associated with the financial markets. It can be modeled by computing the exact option price sensitivities which is also referred to as the option Greeks. These option Greeks play a pivotal role in analyzing the uncertainties observed in financial derivatives with respect to different underlying market parameters like the stock price, volatility rate, time of maturity and interest. Furthermore, several option traders are keen to analyze the option Greeks for hedging the risks associated with the option price. In this context, we provide the applicability of the extended normal distribution for the management of option price sensitivity. We compute some of the well-known option Greeks which play an essential role in determining the decisive measures for financial markets. Thus the proposed work provides a good understanding to the option traders as well as the investors for the smooth management of asset prices, volatility, and portfolio risks.
This paper consists of five sections. In section 2, we provide a brief discussion about the generation of extended normal distribution for skewness and kurtosis different from normal distribution. In this section, we have also presented the corresponding option price for different values of skewness and kurtosis. Section three portrays the matching of Black-Scholes option price with the option price computed by Ki et al. [4] for kurtosis equal to 3 under the extended normal distribution of the returns. Finally, we derive the higher order (up to two) option Greeks under the extended normal distribution in section 4. The paper ends with Conclusion and Future Scope in section 5.

Computation of option price under extended normal distribution

This section deals with a unique concept provided by Ki et al.[4] for the underlying stock returns distribution. Suppose $h_{\mu,\sigma}$represents the Gaussian distribution with mean(μ), standard deviation (σ) and involving other parameters viz., q,λ^2,ω^2given by $q = 3/2 - 9/\beta^2$

$$\lambda^2 = 1 - \frac{1}{q}\sqrt{q(1-q)(\beta/3-1)},$$

$$\omega^2 = 1 + \frac{1}{1-q}\sqrt{q(1-q)(\beta/3-1)}.$$

Ki et al. [4] have managed to design a density function $h_{(\mu,\sigma,\alpha,\beta)}$as given below, for a random variable having non-zero skewness and desired level of kurtosis,

$$h_{(\mu,\sigma,\alpha,\beta)}(z) = \frac{1}{\sigma}\psi_{\alpha,\beta}\left(\frac{z-\mu}{\sigma}\right)$$

Where,

$$\psi_{\alpha,\beta}(x) = q\left\{1+\frac{\alpha}{6\lambda^6}\left(x^3-3\lambda^2 x\right)\right\}g_{0,\lambda}(x)+(1-q)\left\{1+\frac{\alpha}{6\omega^6}\left(x^3-3\omega^2 x\right)\right\}g_{0,\omega}(x)$$

This above defined density function is treated as extended normal distribution with μ,σ,α and β as the mean, standard deviation, skewness and kurtosis respectively. Thus, Ki et al. [4] have provided option pricing formula when ever the underlying stock price moves according to the above discussed distribution and using the moment restriction property:

$$C = S_0\left\{\frac{P}{P+Q}N\left(\frac{D+c\lambda^2}{\lambda}\right)+\frac{Q}{P+Q}N\left(\frac{D+c\omega^2}{\omega}\right)\right\}-Ke^{-rt}\left\{qN\left(\frac{D}{\lambda}\right)+(1-q)N\left(\frac{D}{\omega}\right)\right\}$$
$$+\frac{1}{6}\alpha Kce^{-rt}\left\{\frac{q}{\lambda}\left(\frac{c\lambda^2-D}{\lambda^2}\right)N'\left(\frac{D}{\lambda}\right)+\left(\frac{1-q}{\omega}\right)\left(\frac{c\omega^2-D}{\omega^2}\right)N'\left(\frac{D}{\omega}\right)\right\}$$

Where, the values of P and Q are given by,

$$P = q\exp\left(\lambda^2c^2/2\right)\text{ and }Q=(1-q)\exp\left(w^2c^2/2\right).$$

The value of D is given by

$$D=\left[\ln\left(S_0e^{rt}/K\right)-\ln\left[(P+Q)\left((6+\alpha c^3)\ /6\right)\right]\right]\ /c\ .$$

Where $c = \sigma\sqrt{t}$.

Graphical interpretation

Call option price under Extended normal distribution along with Black-Scholes is plotted in Fig. 1, with skewness (α = 0) and kurtosis (β = 3). As stated in Ki et al. [4], logarithmic of future asset price follows Extended normal distribution with non zero skewness and kurtosis greater than three. For this context, we take kurtosis β = 5 and skewness α = 0.6 for the Extended normal distribution in Fig. 2. It is revealed from Fig. 2 that option price shows deviation from the Black-Scholes price.

In order to have a greater insight, the absolute error of the option price given by Black-Scholes and that of Ki et al. [4] is shown in the Fig. 3.Fig. 4 shows behavior of the option price for a fixed skewness but for different values of kurtosis. It is observed from the Fig. 4, the option price goes on increasing with the increase of kurtosis values.

Computation of option Greeks

Since market price of various assets seem to fluctuate randomly, it is quite difficult to guess the option price of the underlying asset. Option Greeks are of utmost important for maintaining a huge portfolio smoothly. These are also known as sensitivity measures defined as the change of option price corresponding to various underlying parameters like stock price, time to maturity, volatility and interest rates [18]. It helps trader to have a brief idea regarding the portfolio's current position. This suggests whether to take more or less of a particular option contract for an underlying asset. In order to have a better profit with minimum risk, traders must have a precise knowledge about the values of each option Greeks.

Delta

This sensitivity represents the variation in option premium corresponding to the change in stock price [17]. More clearly, if Delta for a particular stock is 0.35 then each one unit increase in the stock price results in 0.35 increases in the option price. It has been observed that Delta always provides positive and negative values for call and put option respectively. The minimum and maximum values of call delta are 0 and 1 respectively whereas that of put delta are -1 and 0 respectively. The sum of absolute values of call Delta and put Delta always gives one. Thus, under extended normal distribution, Delta is computed as,

$$\Delta = \frac{P}{P+Q} N\left(\frac{D}{\lambda} + c\lambda\right) + \frac{Q}{P+Q} N\left(\frac{D}{\omega} + c\omega\right)$$
$$+ S_0 \left\{ \frac{P}{P+Q} N'\left(\frac{D}{\lambda} + c\lambda\right) \frac{1}{\lambda S_0 \sigma \sqrt{t}} + \frac{Q}{P+Q} N'\left(\frac{D}{\omega} + c\omega\right) \frac{1}{\omega S_0 \sigma \sqrt{t}} \right\}$$
$$- K e^{-rt} \left\{ q N'\left(\frac{D}{\lambda}\right) \frac{1}{\lambda S_0 \sigma \sqrt{t}} + (1-q) N'\left(\frac{D}{\omega}\right) \frac{1}{\omega S_0 \sigma \sqrt{t}} \right\}$$
$$+ \frac{1}{6} \alpha K c e^{-rt} \left\{ \begin{array}{l} \frac{q}{\lambda}\left(c - \frac{D}{\lambda^2}\right) N''\left(\frac{D}{\lambda}\right) \frac{1}{\lambda S_0 \sigma \sqrt{t}} + \frac{q}{\lambda} N'\left(\frac{D}{\lambda}\right)\left(\frac{-1}{\lambda^2 S_0 \sigma \sqrt{t}}\right) + \\ \frac{1-q}{\omega} N'\left(\frac{D}{\omega}\right)\left(\frac{-1}{\omega^2 S_0 \sigma \sqrt{t}}\right) + \frac{1-q}{\omega}\left(c - \frac{D}{\omega^2}\right) N''\left(\frac{D}{\omega}\right) \frac{1}{\omega S_0 \sigma \sqrt{t}} \end{array} \right\}$$

Fig. 6, represents call Delta under extended normal distribution with different kurtosis values. The Delta values are quite different from the Black-Scholes Delta. The values of the given Greeks from 51 to 61 and for three different values of the kurtosis are shown in Table 1.

Gamma

This sensitivity is defined as the rate of variation of Delta corresponding to the stock price [18]. It is also obtained by taking the double derivative of option price under stock price. Unlikely Delta, Gamma always provides positive values for both call and put options. However, both call and put have same Gamma values. Gamma attains its maximum when the stock price reaches the strike price.

$$\Gamma = \frac{2P}{P+Q} N'\left(\frac{D}{\lambda} + c\lambda\right) \frac{1}{\lambda S_0 \sigma \sqrt{t}} + \frac{2Q}{P+Q} N'\left(\frac{D}{\omega} + c\omega\right) \frac{1}{\omega S_0 \sigma \sqrt{t}}$$
$$+ S_0 \left[\begin{array}{l} \frac{P}{P+Q} N''\left(\frac{D}{\lambda} + c\lambda\right) \frac{1}{\lambda^2 S_0^2 \sigma^2 t} - \frac{P}{P+Q} N'\left(\frac{D}{\lambda} + c\lambda\right) \frac{1}{\lambda S_0^2 \sigma \sqrt{t}} \\ + \frac{Q}{P+Q} N''\left(\frac{D}{\omega} + c\omega\right) \frac{1}{\omega^2 S_0^2 \sigma^2 t} - \frac{Q}{P+Q} N'\left(\frac{D}{\omega} + c\omega\right) \frac{1}{\omega S_0^2 \sigma \sqrt{t}} \end{array} \right]$$
$$- K e^{-rt} \left\{ \frac{q}{\lambda^2 S_0^2 \sigma^2 t} N''\left(\frac{D}{\lambda}\right) - \frac{q}{\lambda S_0^2 \sigma \sqrt{t}} N'\left(\frac{D}{\lambda}\right) + \frac{(1-q)}{\omega^2 S_0^2 \sigma^2 t} N''\left(\frac{D}{\omega}\right) - \frac{(1-q)}{\omega S_0^2 \sigma \sqrt{t}} N'\left(\frac{D}{\omega}\right) \right\}$$
$$+ \frac{1}{6} \alpha K c e^{-rt} \left[\begin{array}{l} \frac{q}{\lambda^3 S_0^2 \sigma \sqrt{t}} N'\left(\frac{D}{\lambda}\right) - \frac{q}{\lambda^4 S_0^2 \sigma^2 t} N''\left(\frac{D}{\lambda}\right) + \frac{(1-q)}{\omega^3 S_0^2 \sigma \sqrt{t}} N'\left(\frac{D}{\omega}\right) \\ - N''\left(\frac{D}{\omega}\right) \frac{(1-q)}{\omega^4 S_0^2 \sigma^2 t} + \frac{q}{\lambda^3 S_0^2 \sigma^2 t}\left(c - \frac{D}{\lambda^2}\right) N'''\left(\frac{D}{\lambda}\right) \\ + \frac{q-1}{\omega^2 S_0^2 \sigma \sqrt{t}}\left(c - \frac{D}{\omega^2}\right) N''\left(\frac{D}{\omega}\right) + \frac{1-q}{\omega^3 S_0^2 \sigma^2 t}\left(c - \frac{D}{\omega^2}\right) N'''\left(\frac{D}{\omega}\right) \\ \frac{-q}{\lambda^4 S_0^2 \sigma^2 t} N''\left(\frac{D}{\lambda}\right) - \frac{q}{\lambda^2 S_0^2 \sigma \sqrt{t}}\left(c - \frac{D}{\lambda^2}\right) N''\left(\frac{D}{\lambda}\right) + \frac{q-1}{\omega^4 S_0^2 \sigma^2 t} N''\left(\frac{D}{\omega}\right) \end{array} \right]$$

Fig. 8, represents call Gamma under extended normal distribution with different kurtosis values. We have also given the values of the particular Greek from 51 to 61 in Table 1 for three different values of the kurtosis.

Theta

This sensitivity measure gives the idea about the price change for change in time remaining towards the expiration. It has been noticed that whenever expiration approaches both call and put Theta decreases. Therefore this measure always reflects negative values (Neftci S. N., 2008). Keeping stock price, interest rate, volatility of underlying asset constant, Theta will show the amount of option declined. Option Theta behaves differently for at the money, in the money and out of the money option. If the expiration approaches towards in the money or out of the money option, option premium increases. However, if the expiration for out of the money option is far away, option premium goes on decreasing. The value of Theta under extended normal distribution is given by

$$\theta = -S_0\left[\begin{array}{l}\frac{P}{P+Q}N'\left(\frac{D}{\lambda}+\lambda c\right)\left(\frac{D_t}{\lambda}+\frac{\lambda\sigma}{2\sqrt{t}}\right)+\frac{Q}{P+Q}N'\left(\frac{D}{\omega}+\omega c\right)\left(\frac{D_t}{\omega}+\frac{\omega\sigma}{2\sqrt{t}}\right)\\ +N\left(\frac{D}{\lambda}+\lambda c\right)\frac{PQ\sigma^2\left(\lambda^2-\omega^2\right)}{2\left(P+Q\right)^2}+N\left(\frac{D}{\omega}+\omega c\right)\frac{PQ\sigma^2\left(\omega^2-\lambda^2\right)}{2\left(P+Q\right)^2}\end{array}\right]$$

$$+Ke^{-rt}\left\{qN'\left(\frac{D}{\lambda}\right)\frac{D_t}{\lambda}+(1-q)N'\left(\frac{D}{\omega}\right)\frac{D_t}{\omega}\right\}-Kre^{-rt}\left\{qN\left(\frac{D}{\lambda}\right)+(1-q)N\left(\frac{D}{\omega}\right)\right\}$$

$$-\frac{1}{6}\alpha Kce^{-rt}\left\{\begin{array}{l}\frac{qD_t}{\lambda^2}\left(c-\frac{D}{\lambda^2}\right)N''\left(\frac{D}{\lambda}\right)+\frac{q}{\lambda}N'\left(\frac{D}{\lambda}\right)\left(\frac{\sigma}{2\sqrt{t}}-\frac{D_t}{\lambda^2}\right)\\ +\frac{(1-q)D_t}{\omega^2}\left(c-\frac{D}{\omega^2}\right)N''\left(\frac{D}{\omega}\right)+\frac{1-q}{\omega}N'\left(\frac{D}{\omega}\right)\left(\frac{\sigma}{2\sqrt{t}}-\frac{D_t}{\omega^2}\right)\end{array}\right\}$$

$$+\frac{r}{6}Kc\alpha e^{-rt}\left\{\frac{q}{\lambda}\left(c-\frac{D}{\lambda^2}\right)N'\left(\frac{D}{\lambda}\right)+\frac{1-q}{\omega}\left(c-\frac{D}{\omega^2}\right)N'\left(\frac{D}{\omega}\right)\right\}$$

$$-\frac{K\alpha\sigma e^{-rt}}{12\sqrt{t}}\left\{\frac{q}{\lambda}\left(c-\frac{D}{\lambda^2}\right)N'\left(\frac{D}{\lambda}\right)+\frac{1-q}{\omega}\left(c-\frac{D}{\omega^2}\right)N'\left(\frac{D}{\omega}\right)\right\}$$

Fig. 10, depicts the plot of call Theta under extended normal distribution for different kurtosis values. It is quite obvious to check that obtained Theta values are different from the Black-Scholes Theta. These values for different kurtosis are shown in Table 1.

(iv) Rho: This sensitivity measure is associated with the interest rate which is defined as the rate of change of options value corresponding to the change in the value of interest rate (Leoni, P., 2014). It generally does not have any serious impacts for the shorter periods options where as it has a significant impact for the long term options. The Rho value for extended normal distribution is given by:

$$\rho = S_0\left\{\frac{P}{P+Q}N'\left(\frac{D}{\lambda}+\lambda c\right)\frac{\sqrt{t}}{\lambda\sigma}+\frac{Q}{P+Q}N'\left(\frac{D}{\omega}+\omega c\right)\frac{\sqrt{t}}{\sigma\omega}\right\}$$

$$+\frac{1}{6}K\alpha c e^{-rt}\left\{\begin{array}{l}\frac{q\sqrt{t}}{\lambda^2\sigma}\left(c-\frac{D}{\lambda^2}\right)N''\left(\frac{D}{\lambda}\right)-\frac{qt}{\lambda}\left(c-\frac{D}{\lambda^2}\right)N'\left(\frac{D}{\lambda}\right)-\frac{(1-q)t}{\omega}\left(c-\frac{D}{\omega^2}\right)N'\left(\frac{D}{\omega}\right)\\+\frac{(1-q)\sqrt{t}}{\omega^2\sigma}\left(c-\frac{D}{\omega^2}\right)N''\left(\frac{D}{\omega}\right)-\frac{q\sqrt{t}}{\lambda^3\sigma}N'\left(\frac{D}{\lambda}\right)-\frac{(1-q)\sqrt{t}}{\omega^3\sigma}N'\left(\frac{D}{\omega}\right)\end{array}\right\}$$

$$+Ke^{-rt}\left\{(1-q)tN\left(\frac{D}{\omega}\right)-qN'\left(\frac{D}{\lambda}\right)\frac{\sqrt{t}}{\lambda\sigma}+qtN\left(\frac{D}{\lambda}\right)-(1-q)N'\left(\frac{D}{\omega}\right)\frac{\sqrt{t}}{\omega\sigma}\right\}$$

Fig. 12, represents the graph of call Rho under extended normal distribution for different kurtosis values. These Rho values for different kurtosis are shown in Table 2.

Vega

This Greek corresponds to the implied volatility of underlying stock price. It represents the variation of option price corresponding to the variation of implied volatility of the stock price [17]. The difference of stock price and strike price is independent of this option Greek. However it has a significant impact on the time value of money.

$$v = S_0\left[\begin{array}{l}\frac{P}{P+Q}N'\left(\frac{D}{\lambda}+\lambda c\right)\left(\frac{D_\sigma}{\lambda}+\sqrt{t}\lambda\right)+\frac{Q}{P+Q}N'\left(\frac{D}{\omega}+\omega c\right)\left(\frac{D_\sigma}{\omega}+\sqrt{t}\omega\right)\\+\frac{PQ\sigma tN}{(P+Q)^2}\left\{\left(\lambda^2-\omega^2\right)N\left(\frac{D}{\lambda}+\lambda c\right)+N\left(\frac{D}{\omega}+\omega c\right)\left(\omega^2-\lambda^2\right)\right\}\end{array}\right]$$

$$+\frac{1}{6}K\alpha\sqrt{t}e^{-rt}\left\{\frac{q}{\lambda}\left(c-\frac{D}{\lambda}\right)N'\left(\frac{D}{\lambda}\right)+\frac{1-q}{\omega}\left(c-\frac{D}{\omega}\right)N'\left(\frac{D}{\omega}\right)\right\}$$

$$-Ke^{-rt}\left\{qN'\left(\frac{D}{\lambda}\right)\frac{D_\sigma}{\lambda}+(1-q)N'\left(\frac{D}{\omega}\right)\frac{D_\sigma}{\omega}\right\}$$

$$+\frac{1}{6}Kc\alpha e^{-rt}\left\{\begin{array}{l}\frac{qD_\sigma}{\lambda^2}\left(c-\frac{D}{\lambda^2}\right)N''\left(\frac{D}{\lambda}\right)+\frac{(1-q)D_\sigma}{\omega^2}\left(c-\frac{D}{\omega^2}\right)N''\left(\frac{D}{\omega}\right)\\+\frac{q}{\lambda}\left(\sqrt{t}-\frac{D_\sigma}{\lambda^2}\right)N'\left(\frac{D}{\lambda}\right)+\frac{1-q}{\omega}\left(\sqrt{t}-\frac{D_\sigma}{\omega^2}\right)N'\left(\frac{D}{\omega}\right)\end{array}\right\}$$

Where

$$D_\sigma = -\frac{D}{\sigma}-\frac{1}{\sigma\sqrt{t}}\left[\frac{\sigma t\left(P\lambda^2+Q\omega^2\right)}{P+Q}+\frac{3\alpha\sigma^2t^{3/2}}{\left(6+\alpha c^3\right)}\right], D_t = -\frac{D}{2t}+\frac{1}{\sigma\sqrt{t}}\left[r-\frac{\sigma^2\left(P\lambda^2+Q\omega^2\right)}{2(P+Q)}-\frac{3\alpha\sigma^3\sqrt{t}}{2\left(6+\alpha c^3\right)}\right]$$

Fig. 14, represents the graph of call Vega under extended normal distribution for different kurtosis values. One can note that, the Vega values are quite different from the Black-Scholes Vega. We have shown the Vega values in Table 2 for different kurtosis.

All the proposed Greeeks are in close agreement with the corresponding Black-Sholes Greeks for $\alpha = 0$ and $\beta = 3$ as shown in Fig.5, Fig.7, Fig.9, Fig.11 and Fig.13.

CONCLUSION

All the derived Greeks under extended normal distribution differ altogether from Black-Scholes Greeks. It is quite interesting to note that our proposed Greeks coincide with the corresponding Black-Scholes Greeks for zero skewness and three kurtosis. However, as we change the values of the kurtosis from four to six, it is observed that all the proposed Greeks vary monotonically. In particular, Delta and Vega option Greeks are increasing with the increase of kurtosis values. However, Gamma, Theta, and Rho keep decreasing with the increase of kurtosis values. The computation of third and higher order Greeks can be taken up by researchers as future work.

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Table 1: Values of Delta, Gamma and Theta for kurtosis β = 4, 5, 6.

Stock Price	*Delta*			*Gamma*			*Theta*		
	β = 4	β = 5	β = 6	β = 4	β = 5	β = 6	β = 4	β = 5	β = 6
51	0.6460	0.6836	0.7615	0.0199	0.0096	0.0054	-4.6460	-6.9710	-8.8440
52	0.6655	0.6931	0.7699	0.0191	0.0092	0.0052	-4.6900	-7.0410	-8.9300
53	0.6843	0.7021	0.7720	0.0183	0.0089	0.0050	-4.7240	-7.1070	-9.0140
54	0.7022	0.7109	0.7770	0.0175	0.0085	0.0048	-4.7480	-7.1670	-9.0960
55	0.7194	0.7193	0.7817	0.0167	0.0082	0.0046	-4.7620	-7.2230	-9.1750
56	0.7358	0.7275	0.7863	0.0152	0.0077	0.0044	-4.7680	-7.2740	-9.2520
57	0.7514	0.7353	0.7907	0.0144	0.0074	0.0041	-4.7660	-7.3210	-9.3260
58	0.7662	0.7429	0.7949	0.0137	0.0072	0.0040	-4.7560	-7.3640	-9.3980
59	0.7803	0.7502	0.7990	0.0130	0.0069	0.0038	-4.7400	-7.4020	-9.4690
60	0.7937	0.7573	0.8030	0.0123	0.0067	0.0037	-4.7170	-7.4370	-9.5370
61	0.8064	0.7642	0.8067	0.0098	0.0051	0.0032	-4.6890	-7.4680	-9.6030

Table 2: Values of Rho and Vega for kurtosis β = 4, 5, 6.

Stock Price	*Rho*			*Vega*		
	β = 4	β = 5	β = 6	β = 4	β = 5	β = 6
51	23.99	20.16	16.81	22.98	39.75	53.35
52	24.99	20.64	17.09	22.94	40.06	53.84
53	25.98	21.12	17.36	22.83	40.34	54.31
54	26.94	21.59	17.62	22.67	40.59	54.77
55	27.87	22.05	17.88	22.46	40.80	55.21
56	28.78	22.50	18.14	22.19	41.00	55.63
57	29.66	22.94	18.39	21.88	41.16	56.05
58	30.52	23.38	18.63	21.54	41.30	56.46
59	31.34	23.81	18.87	21.15	41.44	56.83
60	32.14	24.23	19.10	20.73	41.50	57.21
61	32.90	24.64	19.33	20.29	41.57	57.58

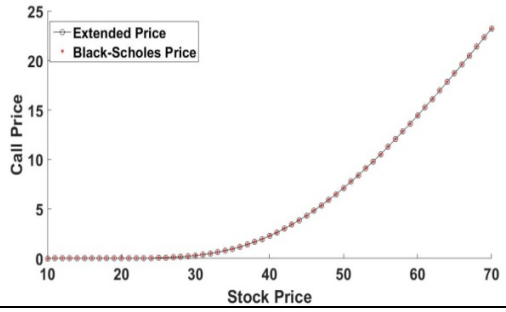

Figure 1: Option price under extended normal distribution for α = 0 and β = 3 along with Black-Scholes price

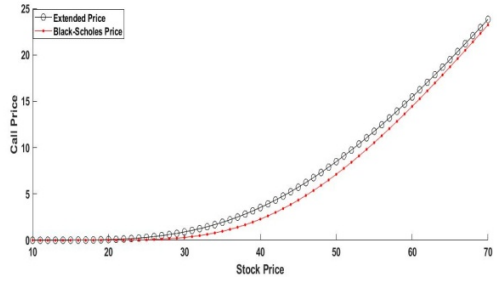

Figure 2: Option price under extended normal distribution for α = 0.6 and β = 5 along with Black-Scholes price.

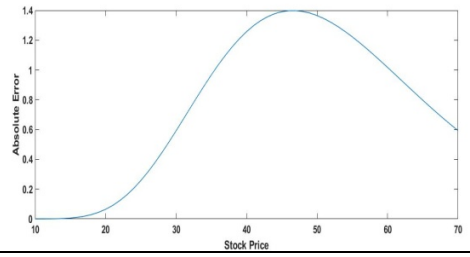

Figure 3: Absolute error between Extended normal option price and Black-Scholes option price.

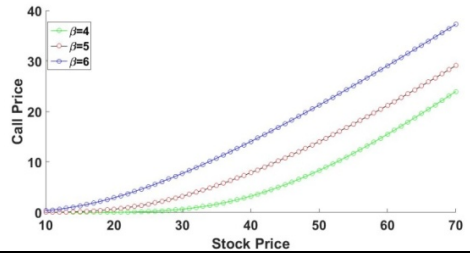

Figure4: Option price under extended normal distribution for $\alpha = 0.6$ and $\beta = 4,5,6$

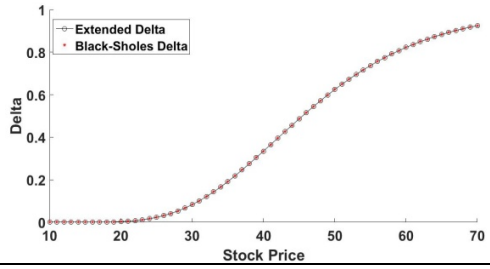

Figure 5: Extended Delta along with Black-Scholes Delta for T =1, $S_0 = 10$, σ=0.3, r=0.05 and K=50

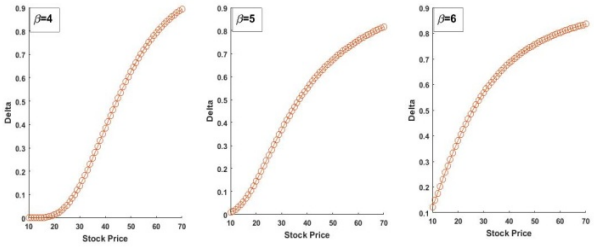

Figure 6: Option Delta under extended normal distribution $S_0 = 10, \sigma = 0.3, r = 0.05$ and $K = 50$ and $\beta = 4,5,6$.

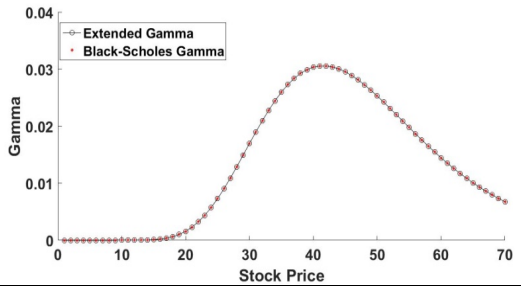

Figure 7: Extended Gamma along with Black-Scholes G $T = 1, S_0 = 10, \sigma = 0.3, r = 0.05$ and $K = 50$

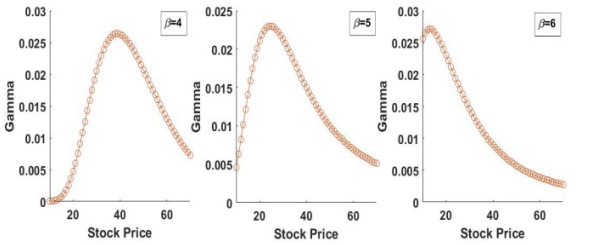

Figure 8: Option Gamma under extended normal distribution $S_0 = 10, \sigma = 0.3, r = 0.05$ and $K = 50$ and $\beta = 4,5,6$.

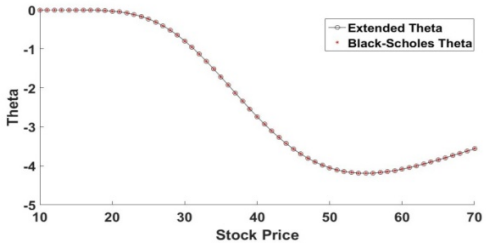

Figure 9: Extended Theta along with Black-Scholes Theta for $T = 1, S_0 = 10, \sigma = 0.3, r = 0.05$ and $K = 50$

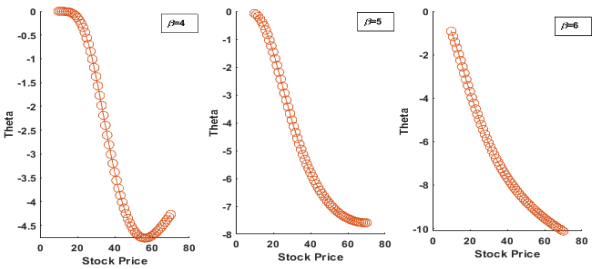

Figure 10: Option Theta under extended normal distribution $S_0 = 10, \sigma = 0.3, r = 0.05$ and $K = 50$ and $\beta = 4,5,6$.

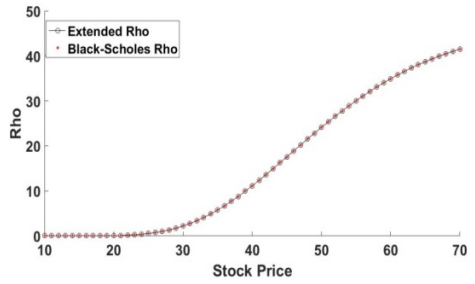

Figure 11: Extended Rho along with Black-Scholes Rho for $T = 1, S_0 = 10, \sigma = 0.3, r = 0.05$ and $K = 50$.

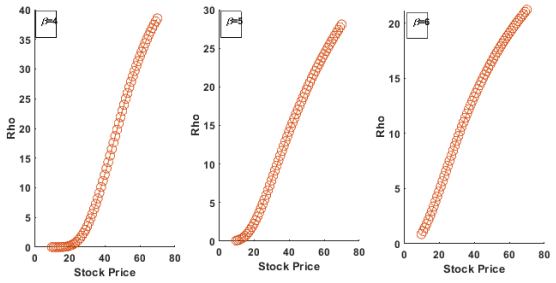

Figure 12: Option Rho under extended normal distribution $S_0 = 10, \sigma = 0.3, r = 0.05$ and $K = 50$ and $\beta = 4, 5, 6$.

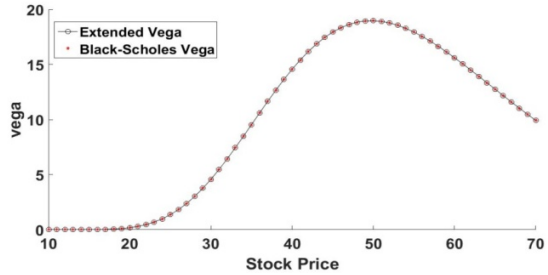

Figure 13: Extended Vega along with Black-Scholes Vega for $T = 1, S_0 = 10, \sigma = 0.3, r = 0.05$ and $K = 50$.

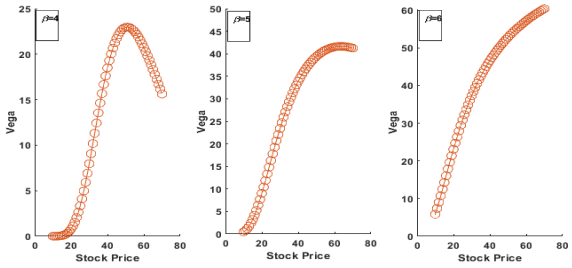

Figure 14: Option Vega under extended normal distribution $S_0 = 10, \sigma = 0.3, r = 0.05$ and $K = 50$ and $\beta = 4, 5, 6$.

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RESEARCH ARTICLE

Assessment of Heavy Metals Concentration in Cow's Food Chains of Madurai District

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ABSTRACT

The extreme urbanization and rapid industrial development during the last decade has caused serious concerns in the environment. In particular, heavy metals are considered as severe pollutants because of their environmental persistence. It can be transferred through food chains and cause heavy damage to the tertiary consumers like human and cow. One of the most severe results of their persistence is the biological amplification of metal in the food chain. Samples of estimate the presence of Cadmium (Cd) and Lead (Pb). Heavy metal levels were assessed by Atomic Absorption Spectrophotometer (AAS).High metal content observed in water, soil and grass at Thirumangalam it reflects in cow's milk. The metals such as cadmium as well as lead concentrations were increased from season I to season II and then to season III in the cow's food chains. This confirms the increasing trend in metal concentrations in cow's food chain. The present study suggested that heavy metals contamination is increasing in the environments particularly in the urban areas, so considerable attention has to be done to monitor the heavy metals level in cow's milk is essential to keep away the health hazards in animals and human beings in Madurai District.

Keywords: Heavy metals, Food chain, Soil, Milk, Health, Pollution .

INTRODUCTION

Milk and its products are the basic requirement for human consumption, especially for infants due to simple and easily digestible protein. Metal contamination in cow's food chain and finally ends with milk and its products are the

major concern (Psenkova et al., 2020). Our environment is highly contaminated by millions of pollutants, which are discharging into the ecosystem from a variety of sources. Particularly heavy metals entry is increasing either naturally or anthropogenically during waste disposal, smelter stacks, atmospheric deposition, sewage sledges, the continuous use of fertilizers as well as pesticides in the agricultural land (Cui et al., 2004, 2005). Moreover metals are considered as severe pollutants due to their environmental persistence (Market, 1998). Also heavy metals can be transferred through food chains and cause heavy damage to the tertiary consumers like human and cow (EEA, 2005). European Union promoted farm to fork approach and it monitor food chain and primary production. Nutritional value of food production depends on the animal, for that reason forage should be free of pollutants because it may be transferred via the food chain finally it can reach human (Miclean et al., 2019). A study conducted by Motovani and Frazzoli., 2010, they conclude the quality of forage is highly influenced through the environment and agriculture practice like fertilizing methodology, harvesting, process and storage. Therefore it is essential to study the transport of hazardous chemical contaminants all the way through the food chain can provide valuable information not only for the improvement of surveillance programs also aimed to ensure the safety of the food supply thereby minimizing the human exposure to toxic agents. Heavy metals entry in to the dairy product might be a serious concern, therefore determination of the heavy metals in milk and getting knowledge to prevent the food risk is a crucial component for an efficient system (Cubadda and Raggi, 2005). In India, urban food security is a subject of rising concern. It is estimated that by 2025, 70% of India's population will be living in urban areas. Prolonged consumption of heavy metal through foodstuffs may cause chronic accumulation of heavy metals in the kidney and liver of humans. This will induce disruption of various biochemical processes thereby leads to cardiovascular, nervous, kidney and bone diseases (WHO, 1992; Jarup, 2003). Hence, the present study has attempted to evaluate the selected heavy metals such as cadmium and lead concentrations in cow's food chains at Madurai District.

MATERIALS AND METHODS

The selected district of study was Madurai and sampling was collected at 10 different sites (in and around Madurai District) during three seasons (starting from January to April, then May to August and finally September to December). Each site is at least 7 to 10 km apart from the next.

Study samples

Collection of samples such as water, soil, grass and cow's milk were done at selected site of Madurai North, South, East and West regions to estimate the presence of Cadmium (Cd) and Lead (Pb). Samples of water, soil, grass and cow's milk were collected from the selected site of Madurai North, South, East and West regions. The present study is focused on the estimation of heavy metals such as Cadmium (Cd) and lead (Pb

Metal analysis

Soil sample(1g)was placed into 100 ml beakers separately, to which 15 ml of tri-acid mixture (70% high purity HNO_3, 65% $HClO_4$ and 70% H_2SO_4) in 5:1:1 ratio) was added. Then mixture was digested at 80^0C till the solution became transparent (Allen *et al.,* 1986). The resulting solution was filtered and diluted to 50 ml using deionized water and was analyzed for concentrations of heavy metals (Cd and Pb) using an atomic absorption spectrophotometer (Modal-ELICO, SL173). Estimation of heavy metals from the sample of grass also done by the method above mentioned (Khan et al., 2007). For milk and ground water sample, 50 ml of sample was digested with 10 ml of concentrated HNO_3 at 80^0C until the solution became transparent (Crounse, 1983;APHA, 2005),and followed the above mentioned.

Statistical analysis

Heavy metals concentrations of samples are presented as Mean ± Standard deviation (S.D) values. Significant differences among metals concentrations and seasons were analyzed by ANOVA through statistical software.

RESULTS AND DISCUSSION

During the season I the concentrations of cadmium were only observed in Thirumangalam (0.002%). Likewise, the maximum lead concentrations were observed Thirumangalam and Vadipatti of Madurai District. Thus the concentration of lead has increased by 0.036% in Thirumangalam and 0.029% in Vadipatti respectively (Fig. 1b). During the season II the cadmium was not detected in Goripalayam, Periyar bus stand, Munichalai and Vandiyur respectively. However, the maximum cadmium concentrations were observed at Thirumangalam and Vadipatti of Madurai District. Thus an increase in cadmium levels by 0.006% and 0.005% respectively (Fig. 1a). Likewise, the minimum concentrations of lead were observed in Periyar bus stand. However, the maximum lead concentrations were observed Thirumangalam and Vadipatti. Thus an increase in concentration of lead was 0.106% in Thirumangalam and 0.095% in Vadipatti respectively

During the season III, the minimum concentrations of cadmium were observed in Periyar bus stand. However, the maximum cadmium concentrations were observed at Thirumangalam 0.006% and Vadipatti 0.004% respectively. Likewise, the minimum concentrations of lead were observed in Periyar bus stand 0.098% and the maximum were observed in Thirumangalam 0.311%. ANOVA test analysis has revealed a considerable variation in the concentrations of metals in the selected sites of Madurai during the season I, II and III ($F_{(4, 10)}=3.48$; $p<0.05$) in water samples. In Madurai District, cadmium concentration in water samples was high at Thirumangalam when compare to other selected sites. However, the level of cadmium concentration in the water samples of Thirumangalam was beyond the permissible limit of Indian Standard (2005) during September to December of the period. Similar observation was found by Momodu and Anyakora (2010) in cadmium contamination of the groundwater in Lagos where 32.65% of the samples had cadmium concentrations above the Maximum Contaminant Level (MCL). Likewise the CDC (2005) is in agreement with the results of the UNEP (2001), which observed mainly the use of galvanized pipes in water distribution system resulted the increased levels of cadmium by 5 to 10 folds in drinking water.

Likewise, higher levels of cadmium in water source may due to high traffic. In addition to that the fragmentation of car tyres is also a possible source of these metals (Elik, 2003). In Madurai District, the increased level of cadmium was due to galvanized pipes in water distribution system, road traffic and other anthropogenic activities. Similarly the concentration of lead in the water samples were also several times more than the permissible limit of Indian Standard (2005) in Thirumangalam and Vadipatti September to December 2010. The corrosion of lead containing plumbing material could also be a potential source of lead in drinking water which is being considered by the USEPA (U.S. Government Printing Office, 2011a). Drinking water in public schools in Seattle, Washington during August 2005 elevated levels of lead more than 20 ppb were reported (Maas et al., 2002).

Similarly, Momodu and Anyakora (2010) reported the groundwater lead level in Lagos. Samples with almost 60% had detectable level of lead while a sample of 36.73% had lead concentration above the Maximum Contaminant Level (MCL) due to the metal contamination in hand dug wells and bore holes of their water supply. In Madurai District, lead pipes and brass fixture materials in drinking water system leads to the corrosion of lead in plumbing material as well as anthropogenic activities is the main source of lead in water bodies. In the present investigation, the water samples of Thirumangalam and Vadipatti at Madurai District contains increased level of cadmium and lead. Concurrently the levels of heavy metals in the all selected sites were promptly very high during September to December 2010 were the actual rainfall is very high 847.6 mm (Dept. of Economics and Statistics, 2010-11) when compare to January to April and May to August rainfall. So flooding is also one of the reasons for increased heavy metals concentration in the water bodies during rainy season in Madurai District. The use of lead pipes for drinking water system, atmospheric pollutant from mines and quarries nearby drinking water source, mixing of contaminated water from sewage and agricultural field particularly in rainy season may be the reasons for the elevated level of cadmium and lead in water of Madurai District predominantly in Thirumangalam and Vadipatti sites during 2010-11.

In the present study of food chains, water is a pivotal component as it is involved in food chains. The metal accumulation in the water may affect the other components of food chain. Suspended metal sediments from water adsorbed into soil (Ahmet Altindag and Sibel Yigit, 2005) that may considerably affect the bio-community possibly through food chain for a long period of time (Yujun Yi et al., 2008). The heavy metal concentration level in the selected soil samples of Madurai District during the season I, II and III were represented in Fig. 2 (a,b) The minimum concentrations of cadmium were observed in Periyar bus stand. However, the maximum cadmium concentrations were observed at Thirumangalam. Similarly, the minimum concentrations of lead were observed in Periyar bus stand. However, the maximum lead concentrations were observed in Thirumangalam in all the three seasons in Madurai District. ANOVA test analysis has revealed a remarkable difference in metal concentrations for the selected sites of Madurai during the season I, II and III ($F_{(4, 10)}$ =3.48; $p<0.05$) in soil samples.

In the present study, the cadmium and lead concentrations in soils of the selected places in Madurai District were lower than the permissible limits of Indian standard (Awashthi, 2000) and European Union standard, 2002 during the experimental period. At the same time in Thirumangalam the study metals were present at high concentrations when compare to other selected sites in Madurai District. Interestingly, the heavy metal levels in all the selected sites be very high during September to December 2010 at 847.6 mm rainfall of (Dept. of Economics and Statistics, 2010-11) when compared to rainfall received from January to April and May to August in the same year. The increasing trend of concentrations of cadmium and lead in all selected sites may be due to soil properties, road traffic, waste water irrigation and pesticides. The soil property is different in Madurai District. Soils are of black, red and laterite. These soil properties might be one of the possible causes for the difference concentrations of heavy metals in soil. Furthermore atmospheric deposition of heavy metals in soil through vehicles is also one of the most important sources in Madurai District. The road traffic was high in all the selected sites and thus it increases the level of heavy metals in the soil. Cadmium and lead are good indicator of contamination in soils due to its presence in gasoline, car components and oil lubricants. The Tibetan Plateau meadow soils were found to be loaded with high content of Cd and Pb due to increasing volume of road traffic (Xuedong Yan et al., 2013) and at Ogbomoso, Nigeria (Adelasoye and Alamu, 2016). Mapanda et al., (2005) reported elevated concentrations of Cu, Zn, Cd, Ni, Cr and Pb in the topsoil of sites irrigated with wastewater compared with the control soils and subsoil.

Industrial effluent and waste waters irrigation has also been considered as potential sources of heavy metals entry into the soil. In Madurai District, most of 1081 factories (Deputy Chief Inspector of Factories, Madurai 2010-11) discharging their waste water without proper recycling treatment and thus helps to accumulate heavy metals in the soil. The Madurai District environment is seriously contaminated with anthropogenic activity in soils and hence continuous environmental monitoring is highly required to have a fertile soil.

The levels of heavy metal concentration in the selected grass samples of Madurai District during season I, II and III were shown in Fig. 3 (a,b). The minimum concentrations of cadmium and lead were observed in Periyar bus stand and the maximum cadmium and lead concentrations were observed at Thirumangalam. ANOVA test analysis has revealed a remarkable difference in the metal concentrations for the selected sites of Madurai during the season I, II and III ($F_{(4, 10)}$ =3.48; $p<0.05$) in grass samples. In the present investigation, the heavy metals cadmium and lead concentrations in grass samples were lies within the permissible limit of Indian standard. At the same time, the metals ranges in grass samples were rapidly increased during September to December (rainy season) than other duration (January to April and May to August). Similar views are reported for the presence of lead concentration in fodder collected from non-industrialized and Pb/Zn smelter area as 2.08±0.22μg/g and 29.06±11.32 μg/g respectively (Swarup et al., 2005). Comparably in another study Pd and Cd concentration in grass sample were (1.14 and 0.044 mg/kg) higher than the present study (Poti et al., 2012).

Onder et al., (2007) observed the lead and chromium contents in grass samples; the highest lead level, 3.39ppm at Alaeddin Hill Park, followed by 2.97ppm at Anit Place and 2.9ppm at Sugar Factory Garden in Turkey. Transportation activities could contribute to the heavy metals accumulation in grass. This can enter into the food

chain because of their intake by roadside edible grasses. Xuedong Yan et al., (2012) observed the same in their investigation of heavy metals (Cu, Zn, Cd, and Pb) concentrations in roadside farmland soil and grasses in and around Kathmandu, Nepal. Carlos E. Diaz-Uribe et al. (2015) indicated 7ppm Zn concentration and 1.1ppm Cu in grasses. These indicate the deposit of metals in the grass will also depend on the distance to vehicles plying road.

Fodder grown on contaminated soils has shown elevated levels of leads and cadmium (Patra et al., 2008). The accumulation of Cu, Zn, and Pb concentrations in the soil samples were found to be higher in the grass samples, since the accumulated metals in the soil can be taken up by plants and then transferred to a higher trophic level (Beeby, 1985). In the present study cadmium and lead were high in Thirumangalam grass samples. This result correlates with the finding of metals in water and soil samples. The grass is cultivated in the waste land in Madurai District. 1081 factories (Deputy Chief Inspector of Factories, Madurai 2010-11) engaging in manufacturing of sugar, automobile components, textile, concrete sleepers calcium sennoside, milk products and non ferrous metal powders predominately add heavy metals into soil that in turn found in grasses. This metal accumulation in grass is again one of the possible ways for the concentrations of same metals in the herbivores body through food chain.

The levels of heavy metal concentration in the selected cow's milk samples of Madurai District during season I (January to April), II (May to August) and III (September to December) were shown in Fig. 4 (a,b). The minimum concentrations of cadmium and lead were observed in Periyar bus stand and the maximum cadmium and lead concentrations were observed at Thirumangalam. ANOVA test analysis has revealed a considerable difference in the concentrations of metals for the selected sites of Madurai during the season I, II and III ($F_{(4, 10)}=3.48$; $p<0.05$) in cow's milk samples. The cadmium level in cow's milk samples of all the selected sites in Madurai District was below the permissible level of IAEA standard and the lead level has increased over the safe limit (Carl, 1991). Similar trend of cadmium concentrations in cow's milk and milk product were found in different countries; 0.001-0.016 $mg.kg^{-1}$ at north of Serbia (Vidovic et al., 2005); 2.13-4.82 $\mu g.kg^{-1}$in Serbia(Suturovic et al., 2014); 0.01-22.80 $\mu g.kg^{-1}$ in Calabria, Italy (Licata et al., 2004); 1.11 $\mu g.kg^{-1}$ in Iran (Shahbazi et al., 2014); 168.25 $\mu g.kg^{-1}$in iron(Razaei et al., 2014); 0.179 $\mu g.kg^{-1}$ in Egypt(Meshref et al., 2014) and 0.40 $mg.kg^{-1}$ in Spain (Martino et al., 2001). It was found to be 0.033 $mg.l^{-1}$ for the unpolluted area, 0.057-0.265 $mg.l^{-1}$ for the regions around plants and smelters in India (Patra et al., 2008) and 0.089 and 0.062 $mg.l^{-1}$ in Pakistan (Javed et al., 2009). These values were found to be below the permissible limit.

Moreover, the cadmium concentrations in milk depend on the cadmium load in the food production environment (Olsson et al., 2002). This is observed in the work of Tu et al., (2007) stating that feeding crops add more cadmium to the milk of cow. The lead levels in milk is around 0.25$mg.l^{-1}$ in the unpolluted area, it was between 0.65-0.85$mg.l^{-1}$ in plant and smelter areas in India (Patra et al., 2008); 0.23 $mg.l^{-1}$in Brazil (Soares et al., 2010); 0.03mg/kg^{-1}in Mexico(Castro-Gonzalez et al., 2017); 2.12-37.36 $\mu g.kg^{-1}$ in Brazil(Oliveira et al., 2017); 14 $\mu g.kg^{-1}$in Iran(Shahbazi et al.,2016); 96.25ng/kg^{-1} in Iran (Nejatolahi et al., 2014); 0.28mg/kg^{-1}in Iran(Najarne-Zhad et al., 2015); 0.751 $\mu g.kg^{-1}$ in Egypt(Meshref et al., 2014) and 21.78 $mg.l^{-1}$ in Pakistan (Javed et al., 2009). However in Faisalabad, Pakistan, the Pb level was 19.972$mg.l^{-1}$ that exceeded in several fold than the permissible limits of European standards (Aslam et al., 2011). The lead concentration was found to be higher than the permissible limit. In cow and buffalo milk, the concentration varied from ND-36.6$mg.l^{-1}$ and 4.0-25.2$mg.l^{-1}$ respectively in Madras city (Ayyadurai et al., 1998). In a study, by Marshall et al. (1998) indicated that the level of lead contents increased in cow's milk is due to the intake of huge quantities of lead via forages.

The lead contents in cow's milk samples was varied between 22.1-59.2$\mu g.l^{-1}$ (Inam and Somer, 2000). Moreover, the mean concentrations of Pb in southern and northern regions of Croatia were 36.2 and 58.7 $\mu g.1^{-1}$ and it exceeded the maximum recommended level (Nina Bilandzic et al., 2011). Simsek et al. (2000) observed Pb levels in an industrial area (0.049$mg.kg^{-1}$) and in areas with heavy traffic (0.032$mg.kg^{-1}$). Lead concentrations in cow's milk at different regions were analyzed; 9.92$\mu g.kg^{-1}$ at Calabria, Italy (Licata et al., 2004); 19.972$mg.l^{-1}$ in some parts of Italy (Aslam et al., 2011); 2.10 to 39.40$\mu g/l$ in Iran. These high levels of lead concentration in milk may cause from industrial air pollutions (Seyed Mohammad et al., 2012). The presence of high cadmium and lead in cow's milk at Madurai District

may be arise due to different factors such as waste water irrigation, climatic factors, industrial activities, domestic wastes in roadways and inordinate use of pesticide compounds. According to Rahimi et al., 2013, when the age of animal increased the concentration of heavy metals in milk also increased. His study shows the concentration of Pb(7.91ng/ml) and Cd (1.40 ng/ml) in animal aged below 3 year old the levels of Pb And Cd were lower (11.8 and 2.69 ng/ml respectively) in animal with more than 3 year. In order to assess the extent of biomagnifications of heavy metals from grass to cow's milk, the present study exposed heavy metals concentration in the cow's milk samples of the selected sites in Madurai District during 2010-11 The findings indicate that there is high bio-magnification of heavy metals such as cadmium and lead in cow's milk. It means that increased concentrations of heavy metals from one tropic level to another tropic level in the food chain were observed.

CONCLUSIONS

In the present study, the heavy metals concentration was very high at Thirumangalam in each study samples of cow's food chain such as water, soil and grass. Finally it reflects in cow's milk. The metals such as cadmium as well as lead concentrations were increased from season I to season II and then to season III in the cow's food chains. This confirms the increasing trend in metal concentrations in cow's food chain. For a good quality cow's milk, nutritive fodder is indispensable. Most of the cow was fed with fodder grown in highly contaminated areas and road sides. This leads to the accumulation of metals in cow's milk through food chain. The consumption of cow's milk containing cadmium and lead for a long period may affect animal and human being health. The present study suggested that heavy metals contamination is increasing in the environments particularly in the urban areas, so considerable attention has to be done to monitor the heavy metals level in cow's milk is essential to keep away the health hazards in animals and human beings in Madurai District.

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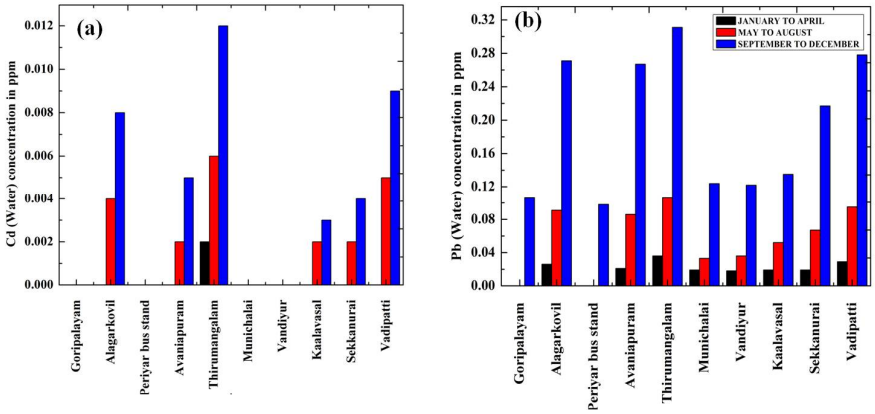

Fig. 1. (a) Cadmium concentration (ppm) in water (b) Lead concentration (ppm) in water

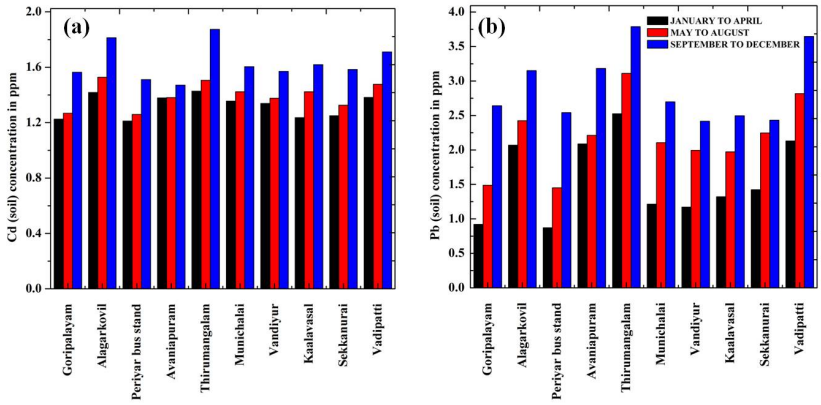

Fig. 2. (a) Cadmium concentration (ppm) in soil (b) Lead concentration (ppm) in soil

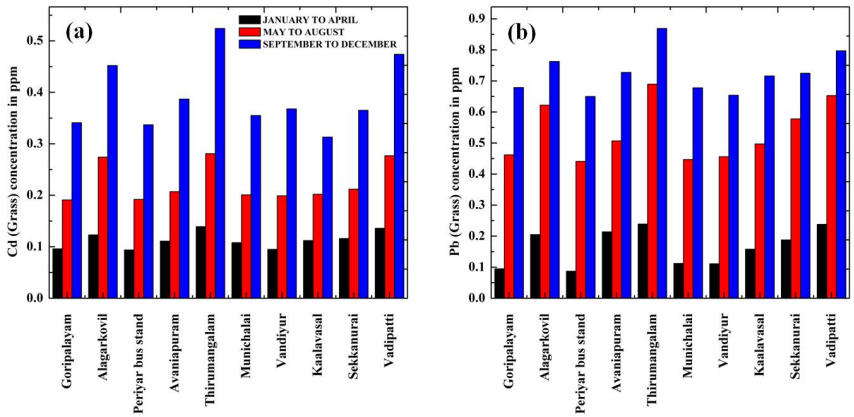

Fig. 3. (a) Cadmium concentration (ppm) in grass (b) Lead concentration (ppm) in grass

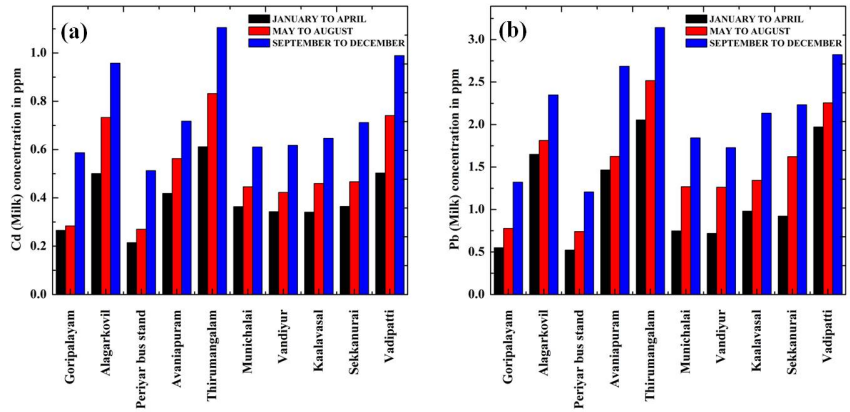

Fig. 4. (a) Cadmium concentration (ppm) in milk (b) Lead concentration (ppm) in milk

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RESEARCH ARTICLE

Effect of Aerobic Exercise in Improving Pulmonary Status in Asthma Patients

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ABSTRACT

The study is to find the effect of Aerobic exercise to improve exercise tolerance and to reduce dyspnea in asthma patients. 20 asthma patients between 40-55 years of age were selected randomly using simple random sampling method. The pretest measurement of exercise tolerance and dyspnea was measured using six minutes walk test and modified medical research council dyspnea scale for all the subjects. After the pretest assessment the subjects received. Aerobic exercise for a period of 8 weeks and on the end of 8th week posttest measurement of exercise tolerance and dyspnea was done using the six minute walk test and modified medical research council dyspnea scale for the group in a similar fashion as that of pretest measurement. The results of the study concluded that Aerobic exercise improved exercise tolerance and dyspnea reduction in asthma patients.

Keywords: Asthma, Aerobic exercise, Exercise tolerance test, Dyspnea

INTRODUCTION

Asthma disease is considered as an inflammatory disease in the airway, thus resulting in increased airway responsiveness, obstruction, mucus hyper-production and involvement in the airway wall repairing. Asthma has been interchangeably called as bronchial asthma (BA) as the anatomical involvement specifies. The management of Bronchial asthma had always been a challenge to the physicians and the physiotherapist as it involves an extensive pathological dysfunction. The theory has now been enlarged to involve the exposure to symbiotic bacteria and the parasites are as main modulators of the immune system, along with the infectious agents [1]. Recently, the asthma has not been acknowledged as a simple Th2 disease, which is featured by IgE upgrading and somewhat eosinophilia. The Th17 and Th9 cell sub types are well known to contribute the swelling or increasing the smooth muscles contraction or stimulating the mast cells [2]. Asthma is a chronic airway swelling disorder of the lungs that

leads to structural and functional changes, thus resulting in increased bronchial responsiveness and the airflow stoppage. Exacerbations might be fatal and these are more repeated and more serious in high risk clients or clients with uncontrolled asthma. Factors involves viral infections, allergens, tobacco smoke, physical exercise, stress, some medications like non-steroidal anti-inflammatory drugs and beta-blockers might trigger or even worsen asthma symptoms. [3-5]. Some of the phenotypes are identified, such as allergic asthma, non-allergic asthma, and late arising asthma. During quiet breathing, the primary muscle responsible for ventilation is the diaphragm. Bronchodilatation, gaseous exchange improves exercise tolerance. The aim of the study is to find the effect of Aerobic exercise to improve pulmonary status in asthma patients. The study is essential as most of the general population suffers from this problem and also to make physiotherapists to realize the benefits received from the alternative approaches like Aerobic exercise to improve exercise tolerance and dyspnea reduction in asthma patients [2].

MATERIALS AND METHODOLOGY

20 acute asthma patients attending Vinayaka Missions Kirupananda Variar Medical College, Salem between 40 and 55 years of age were selected randomly using simple random sampling method are included for the study. Patients having cardiac and psychiatric problems are excluded from study. The group underwent a pretest assessment of exercise tolerance test using six minute walk test. Dyspnea was measured using modified medical research dyspnea scale. Materials like chalk powder, stop watch, whistle, meter tape were used to collect the data for this test. A hard and flat 200 meters walkway was marked for six minute walk test. Subjects were asked to stand in the start line and were instructed to walk in their self pace and rest as needed back and forth along the marked walkway for a period of six minutes following a whistle blow. Stop watch & whistle were used to start and stop the test. The distance walked was measured by multiplying the number of times of full completion of marked walkway with 200 meters and the excess using a meter tape. The distance walked in six minutes was recorded with a help of a meter tape in meters. Dyspnea scale consists of readings from 0 to 10. According to dyspnea level the values are noted.

Aerobic Exercise treatment includes submaximal treadmill training.

PHASE 1 (WARMUP PERIOD): In the warm up period patients were instructed to do the stretching exercise of trunk and lower extremities, slow jogging and walking for 10 minutes.

PHASE II (AEROBIC EXERCISE PERIOD): In the aerobic exercise period patients were instructed to do the individualized walking programme in treadmill. Intensity of training started with 40 percentage of maximum heart rate gradually and progressed upto 6 percentage maximum heart rate. Duration of training started with 20 minutes and gradually progressed to 30 minutes. Frequency of training was 3 days for first week and gradually progressed upto 5 days /week. The training lasted for a period of 8 weeks totally.

PHASE III (COOL DOWN PERIOD): In the cool down period patients were instructed to do the stretching exercise of trunk and lower limbs, jogging and walking with slow intensity for 10 minutes. Post test assessments were taken from all the 15 patients in a similar manner as that of the pretest assessment on the final day of 8th week of training. All the values of pre and post test assessments were noted down.

RESULTS AND DISCUSSION

The results of the study were derived from the statistical analysis using the paired t-test. The results using a paired t-test revealed that there is a significant improvement in and exercise tolerance and dyspnea reduction in asthma patients. The results of the study showed that difference between the pretest and posttest mean values were statistically significant thereby indicating in exercise tolerance had significantly improved and dyspnea was reduced following Aerobic exercise for a period of eight weeks training. The improvement in exercise tolerance and dyspnea reduction may be because due to increased capillary density, myoglobin content, mitochondrial enzymes and the concentration of glycogen. Inspiratory muscle strength is improved which prevents alveolar collapse and respiratory muscle performance is increased [6]. Rasmussen et al reported about the Aerobic exercise significantly improved

tidal volume, minute ventilation and reduced frequency of breathing [2]. Belman, et al [3] reported the Aerobic exercise improved ventilator muscle performance, increased maximal sustain ventilator capacity, oxygen consumption reduces the perception of dyspnea, and increases exercise tolerance.

CONCLUSION

The results of the study make us to conclude that Aerobic exercise improved Exercise tolerance and dyspnea reduction in asthma patients.

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Nil.

CONFLICT OF INTEREST

The authors have none to declare.

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Table No 1: The collected data were analyzed using paired't' test

S. No	Variables	't' calculated value	't' tab value
1	Exercise capacity	8.0	2.145
2	Dyspnea	13.74	2.145

t calculated value > t table value. The values show a significant improvement in both exercise capacity and dyspnea reduction.

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RESEARCH ARTICLE

Screening and Evaluation of Biodegradability of Polythene by Soil Bacteria

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ABSTRACT

Increase in plastics has resulted in the degradation of environment and other life forms because of its non-degradable property and persistent presence in the soil. The rise in plastics may lead to various changes in the regulation and recycling of waste resources. In order to avoid such problems, plastics are now degraded biologically with the help of microbes. The present study deals with the isolation of such potent bacteria, isolated from various soils that are capable of degrading plastics. Five different strains of bacteria such as *Streptococcus, Staphylococcus, Clostridium, Proteus* and *Pseudomonas* species were isolated from various soil sources and identified based on their morphological characters and biochemical test results. The biodegradability of 10 micron plastics by these bacterial strains were determined for 15 days and it was found that *Pseudomonas sp.* was able to reduce the plastics by 70% whereas *Clostridium sp*. did not degrade the plastics. Biodegradation of plastics by bacteria can be made most efficient by altering the factors that govern the process. It promises a reduction in plastic pollution in the future. Hence it is recommended to perform the enzymatic test of plastic samples, and production of isolated enzyme in large scale for degradation of plastic material.

Keywords: Bacteria, soil, plastic, biodegradation, morphology

INTRODUCTION

One third of the plastic manufactured is used for packing and is therefore rapidly discarded. The discarded plastic gets accumulated in landfills, natural terrestrial habitats or in the ocean [1]. Recycling of plastics is not always economically possible so it becomes necessary to study the various methods of biodegradation of plastics. Plastic waste might eventually end up in composts along with other biodegradable waste. Studying the biodegradation of plastic in natural composts will help in understanding the eventual fate of such plastic waste. Plastics can be degraded by chemical, thermal, photo or biological degradation. Biological degradation is generally considered as a phenomenon of biological transformation of organic compounds by living organisms particularly microbes. It has been considered as a natural process in the microbial world as carbon and energy source for their growth and takes a key role in the recycling of materials in the natural ecosystem [2]. The microorganism's role is very important for plastic degradation. The different types of microbes degrade different groups of plastics. Microorganisms such as *Bacillus megatserium*, *Pseudomonas* sp., *Azotobacter sp.*, *Ralstonia eutropha*, *Halomonas* sp., etc are used to degrade plastics [3]. In addition, *Bacillus brevis*, *Acidovorax delafieldii*, *Paenibacillus amyloticus*, *Bacillus pumilus*, *Bordetella petrii*, *Pseudomonas aeruginosa*, *Shewanella* sp. are examples of bioplastic degrading bacteria [4]. In addition to these strains, a thermophilic bacterium, *Bacillus brevis*, with PLA-degrading properties has been isolated from soil. In the last ten years, several biodegradable plastics have been introduced into the market. However, none of them is efficiently biodegradable in landfills. For this reason, none of the products has gained widespread use. There is an urgent need to develop efficient microorganism and their products to solve this global issue. Hence in the present study bacteria from the soil is isolated and evaluated for its efficiency in degrading plastics.

MATERIALS AND METHODS

Sample collection

For isolation of different species of degrading polythene micro-organisms three soil samples were collected at depth of 3-5cm from different sites in Thoothukudi (highly contaminated with plastic wastes) namely dumped soil of municipal wastes, government hospital, and garden soil. These samples were collected in sterile containers, and transported to the lab for further analysis. Polythene samples of 10 micron density were purchased from stationary shop of Thoothukudi.

Isolation of soil bacteria

The soil bacteria were isolated by spread plate technique [5]. 1g of plastic contaminated soil sample was taken and mixed in 100 ml of distilled water in a conical flask and serially diluted (10^1 to 10^5). The diluted samples (1ml) were inoculated onto nutrient agar by spread plate technique and incubated at 37^0C for 24 hrs.

Identification of soil bacteria

The selected bacterial isolates were identified by morphological and biochemical characterization using Bergey's Manual of Determinative Microbiology [6].

Pre-Treatment of Polythene

The 10 micron polyethylene bags were cut into the small strips and transferred onto a beaker with distilled water and aseptically placed in the 70% ethanol solution for 30 minutes. Finally the polyethylene strips were transferred to a petri dish and used for further studies.

Degradation of polythene bag

Nutrient broth was prepared and autoclaved at 121°C for 15 minutes. 100 ml of cooled, nutrient broth was poured into eight 10 ml sterile test tubes. The sterile pre weighed polythene bag pieces were aseptically transferred into

nutrient broth. A loopful of bacterial cultures such as *Bacillus*, *Staphylococcus* and *Pseudomonas* sp. was inoculated into nutrient broth. One test tube containing the polythene bag pieces without bacterial cultures was maintained as control. These test tubes were incubated at 37°C for 5, 10, and 15 days. The polythene bag pieces were carefully removed from the culture (by using forceps) after different days of incubation. The collected pieces were washed thoroughly with tap water, ethanol and then distilled water. The pieces were shade dried and weighed for final weight. The data were recorded. The same procedure was also repeated for all the treated samples.

Determination of weight loss

The percentage of degradation of polythene bag pieces by the bacterial strains was determined by calculating the percentage of weight loss of plastics. The percentage of weight loss was calculated by using the following formula.

$$\text{Percentage of weight loss} = \frac{\text{Initial weight - Final weight} \times 100}{\text{Initial weight}}$$

RESULTS

A total of five bacteria were recovered from different areas such as dumped soil of municipal wastes (S1), government hospital (S2), and garden soil (S3). Out of five bacteria three of them were positive and the other two were negative.

Isolation of Soil Bacteria: In the present investigation the bacteria were isolated using serial dilution and spread plate technique and the number of bacteria was calculated by total heterotrophic count and was denoted as CFU/ml. The highest number of bacterial colonies was obtained from the municipal waste soil samples (506) at a dilution of 10^{-1} having the value of 5.06 x 103 CFU/ml and the lowest number of bacterial colonies was obtained from garden soil (7) at a dilution of 10^{-4}.

Identification of Soil Bacteria: From the bacterial colonies, pure cultures were made by means of streak plate method (Plates 4). Specific bacterial species were identified based on microscopy, cultural characteristic and biochemical tests. The organisms were identified as *Streptococcus sp.*, (SB1) *Clostridium sp.*, (SB2), *Proteus sp.*, (SB3), *Staphylococcus sp*. (SB4) and *Pseudomonas sp*. (SB5) respectively (Table 1 & 2). It was observed that SB1 is gram +ve (*Streptococcus sp.)* which showed positive results for tests like citrate utilization and carbohydrate fermentation and negative for tests such as catalase, Voges-Proskauer, indole production and hydrogen sulphide. SB2- *Clostridium sp.* is gram +ve, with positive result for carbohydrate fermentation and negative for tests like catalase, nitrate reduction and indole production. SB3 – *Proteus sp.* is gram -ve and showed positive results for methyl red, citrate utilization, hydrogen sulphide, carbohydrate fermentation and gelatin and negative for indole production test. SB4 was observed to be *Staphylococcus sp*., a gram +ve bacteria that showed positive results for tests such as catalase, methyl-red, Voges-Proskauer, citrate utilization and carbohydrate fermentation and negative for indole production and hydrogen sulphide tests. SB5- *Pseudomonas sp*. is gram –ve with positives results for catalase and citrate utilization and negative for methyl-red, Voges-Proskauer, indole production and hydrogen sulphide tests (Table 1 & 2).

Degradation of polythene bag: The degradation potential of *Streptococcus sp.,* (SB1) *Clostridium sp.*, (SB2), *Proteus sp.*, (SB3), *Staphylococcus sp*., (SB4) and *Pseudomonas sp*. (SB5) were 23.3%, 0%, 6.7%, 50% and 70% respectively for 10 micron plastic. The isolate which showed maximum degradation of 70% was *Pseudomonas sp.*, (SB5) for 10 micron polythene. Maximum degradation percentage was observed during 15 days intervals and minimum degradation was shown by isolate SB3 (*Proteus sp.*). No degradation was shown by *Clostridium sp*. (SB2). During 10 days' time interval maximum degradation for 10 micron polythene was shown by *Pseudomonas sp*. and minimum degradation was observed against SB3 (*Proteus* sp.) and no change was shown by SB2 (*Clostridium sp*.). There was no significant difference between the different species (SB1, SB2, SB3, SB4 and SB5) of bacteria on polythene degradation for 5 days (Fig).

DISCUSSION

Similar to the above study, *Pseudomonas aeruginosa, Pseudomonas putida, Bacilis subtilis* and *Aspergillus niger* were isolated from soil samples in a refuse site [7]. It was found that the micro-organisms used in the experiment did not bring about any significant change in the biomass of LDPE. In another study it was reported that *Streptomyces, Pseudomonas, Bacillus, Staphylococcus, Aspergillus nidulans and Aspergillus flavus*, isolated from garbage soil samples biodegraded LDPE powder [8]. Different strains of bacteria such as *E.coli, Staphylococcus, Pseudomonas, Klebsiella and Bacillus* were recovered from polyethylene dumped areas that can be interacted with polyethylene and degraded to some extent by microbes [9]. The present results were comparable with earlier reports [10,11] which concluded that the plastic associated soils are rich in bacterial species. Bacterial species importantly involved in the biodegradation process include, *Bacillus* (capable of producing thick-walled endospores that are resistant to heat, radiation and chemical disinfection), *Pseudomonas*, *Klebsiella*, *Rhodococcus*, *Flavobacterium*, *Comamonas*, *Escherichia*, *Azotobacter* and *Alcaligenes* [12]. Equivalent to the findings of the present study the degradation of polyvinyl alcohol (PVA) plastic bags by using the different isolate of pseudomonas and bacillus *(Bacillus amylolyticus, Bacillus firmus Bacillus subtilis, Pseudomonas putida, Pseudomonas fluroscence)* were carried out which proved microbes cause greatest degradation of polythene and plastics. Among the bacteria, *Pseudomonas putida* followed by *Bacillus subtilis, Bacillus amyloliticus Bacillus firmus, Pseudomonas fluroscence,* have greater degradation ability. It was also reported that the weight loss form *Streptomyces* species is 46.16% of polythene and 35.78% of plastics. The biodegradation of polythene by bacteria was 2.19% to 20.54% for polythene and 0.56% to 8.16% for plastics. Among all the species, *Aspergillus glaucus* was more active than *A. niger* in degrading 28.8% of polythene and 7.26% of plastics within a month [13]. *Penicillium sp*. was more active in reducing LDPE i.e upto 6.58% compared to *Aspergillus fumigatus* as it reduced the weight upto 4.65% [14].

CONCLUSION

Biodegradation of plastics by bacteria can be made most efficient by altering the factors that govern the process. It promises a reduction in plastic pollution in the future. Hence it is recommended to perform the enzymatic test of plastic samples, and production of isolated enzyme in large scale for degradation of plastic material. Another alternative to synthetic plastics is bioplastics which are biodegradable and are produced using renewable biological sources. These renewable sources can be plant, seaweed, and microbial sources. According to recent studies, bioplastics from sea weeds are still under research and make a good future prospective for bioplastic manufacture.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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Table 1: Gram staining and Motility tests of the isolated bacterial cultures

Bacterial Strain no	Strain	Shape of the organism	Colour	Gram Staining	Motility	Characteristic Bacteria
SB1	PLRW	Cocci	Purple	Gram +ve,	Non-motile	*Streptococcus sp.*
SB2	PSRT	Rod	Purple	Gram +ve	Non-motile	*Clostridium sp.*
SB3	PSIT	Rod	Pink	Gram –ve,	Motile	*Proteus sp.*
SB4	PSIY	Cocci	Purple	Gram +ve	Non-motile	*Staphylococcus sp.*
SB5	PLRP	Rod	Pink	Gram –ve,	Motile	*Pseudomonas sp.*

Table 2: Biochemical tests of the isolated bacterial cultures

Bacterial Strain no	Catalase Test	MR Test	VP Test	Citrate Utilisation Test	Nitrate Reduction Test	Indole Production Test	H_2S Test	Carbohydrate fermentation Test	Gelatin Test
SB1	-	-	-	+	-	-	-	+ /gas formed	-
SB2	-	+	+	+	-	-	+	+ /gas formed	-
SB3	-	+	+	+	-	-	+	+ /gas formed	+
SB4	+	+	+	+	-	-	-	+ /gas formed	-
SB5	+	-	-	+	-	-	-	+ /gas formed	-

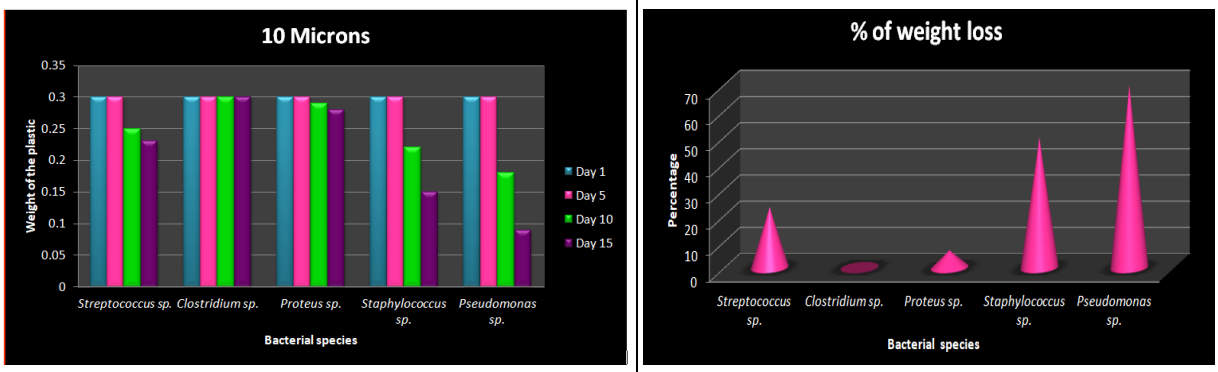

Fig.1. Graph showing the degradation of 10 microns polythene from Day 1-15

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REVIEW ARTICLE

Depression and Antidepressant Drugs

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ABSTRACT

Depression is a condition of low mood and unwillingness to do work marked by a depressed mood, lack of interest, decreased motivation, and inability to concentrate. The "stimulation of MAO-A" and the suppression of NA and 5-HT are the causes of the sickness. Some of the symptoms include decreased pleasure interest, feelings of worthlessness or inappropriate regret, decreased appetite and libido, insomnia, and frequent thoughts of death or suicide. Various synthetic medications are used in the treatment of depression, but there aren't enough to make patients happy, and even synthetic drugs can have adverse effects. Therefore, after decades of infatuation with modern medicine, people turn to old medicinal systems like "Ayurveda, Siddha, and Unani". Depression affects an estimated 676 million people (one out of every ten). In 2012, 804,000 people died by suicide worldwide; depression has risen to the top of leading causes of death in "young adults" (15-29 years), next to traffic accidents. Thus, the principal idea of this article is to review the available information about depression, its causes, its types, mechanism, etc. It is also about antidepressants drugs and their mechanism of action studied and researched until today.

Keywords: Depression, Antidepressant, Serotonin 5 HT, Monoamines, Neurotransmitter, Mental Health.

INTRODUCTION

Depression is a widespread psychological illness that manifests as a depressed frame of mind, a lack of interest or joy, lack of energy, guilt feelings or low self-esteem, disturbed rest or desire, and helpless obsession. Also, wretchedness is frequently associated with signs of unease. These issues can get chronic or repetitive and lead to

generous impedances in a person's ability to deal with their regular obligations. More than 264 million people of all ages suffer from depression around the globe. Every year, about 800,000 individuals commit suicide, with one person dying every 40 seconds". (WHO2020). (Mental Health, 2021; The World Health Report, 2001). "Depression is a critical commitment to the worldwide burden of sickness and impacts individuals taking all things together networks across the world. Today discouragement is assessed to impact 264 million people. The World Mental Health, directed in 17 nations, tracked down that on regular around 1 of every 20 individuals having a scene of sadness in the past year. Depressive confusion regularly begins at a young age; they diminish individuals' working and frequently are repeating. Therefore depression is the primary source of inability worldwide regarding complete year misfortune because of disability. The interest in checking depression and other psychological health conditions is expanding worldwide. Suicide is the significant outcome in the majority of burdensome illnesses. About 60% of death are because of depression and depression-related disorder. Chronic stress is one of the fundamental triggers of actuating despondency, even though the mechanism of provoking depression isn't unmistakably settled". (Ashwani & Preeti, 2012; Mannan et al.,2015). It happens in people of all sex, ages and foundation. Depression was additionally twice as essential in females as males. Any unpleasant life occasion is the manifestations of the introductory phase of depression; consequently, depression is regularly thought a stress-related disorder. As indicated by the World Health report, roughly 450 million individuals suffer from the consequences of a psychological or societal problem. The high rate of suicide in depressed individuals, combined with stress-related complications and their effects on the cardiovascular system. (Singh et al.,2013).

While "depression" is the primary cause incapacity in both males and females, ladies have a 50% higher burden of depression than males (WHO, 2008). "Indeed, depression is the primary source of disease burden for ladies in big league salaries and low-and centre pays nations" (WHO, 2008). (Marcus et al., 2012).Symptoms of Depression, include a low mood, a lack of interest and happiness, and increased fatigability. Depending on the number and severity of symptoms, a depressive event can be classified as mild, moderate, or severe. Person suffered from an average depressive episode, on the other hand, may find it difficult to continue with daily tasks and social activities; yet, they are unlikely to quit working entirely. On the other hand, during a severe depressive episode, it is doubtful that the victim will wish to engage in social work or home tasks, except to a minimal extent. The bipolar affective disorder typically comprises equally manic and depressive episodes isolated by the typical frame of mind. "Mania episodes" include raised state of mind and expanded energy, resulting in over activity, the pressure of speech, and diminished rest requirements. (Faquih et al., 2019)Depression is associated with significant impairments in social, marital, and occupational performance, as well as significant psychological and interpersonal distress. Antidepressants plus psychotherapy (talk therapy) can be used to treat depression. Other depression treatments are Light Therapy ,Electroconvulsive therapy (ECT), Transcranial and Magnetic Stimulation (TMS), which may relieve symptoms of depression in winter". The most widely accepted biochemical theory of depressed disorder is the monoamine hypothesis, which holds that depression is produce by a functional shortage of monoamines such as serotonin, noradrenaline, and dopamine. It had been suggested that any drug or compound that inhibit the reuptake of these neurotransmitters has proven to be an effective antidepressant. Inflammatory such as IL-6, TNF-α is also found to be high in patients having depression. (Ashok Kumar et al., 2014; Beirão et al., 2020; Marcus et al., 2012; Sharan, 2010).

MATERIALS AND METHODS

Pathophysiology of depression

Over time there are no biomarkers or imaging abnormalities that can be used to find out the pathophysiology of depression. A postmortem examination of the brain reveals no significant structural or neurochemical abnormalities. The vast majority of currently available drugs were developed through trial and error. The "amine hypothesis" underpins the majority of current theories. The majority fundamental hypothesis for mood disorder is that changes in biogenic amine levels cause it. According to the idea, a functional deficit of catecholamines, mainly norepinephrine, causes depression (NE). In contrast, mania is produced by an applicable surplus of catecholamines

at the brain's essential synapses. Changes in the degrees of biogenic amines in the mind, like NE, dopamine (DA), and epinephrine, indolamine, serotonin, 5-hydroxytryptamine (5-HT), and two catecholamines, have been connected to the occurrence of depression. (Beirão et al., 2020; Marcus et al., 2012; RICHELSON, 1994).

Types of Depressions: (Ashwani & Preeti, 2012)
It's normal to feel down every so often, yet if you're miserable constantly and it's influencing your day by day life, you could be experiencing clinical depression. It's a condition that can be treated with a drug, conversing with a therapist, and making life changes. Depression arrives in an assortment of structures. Some are brought about by occasions in your day to day existence, while synthetic changes in your mind cause others.

Major Depressive Disorder: "Major depressive disorder" is regarded as recurring episodes of major depression and is a severe and chronic condition. "Major depressive disorder occupied 4.4 per cent of the overall disease number worldwide". The severity of major depression can range from mild to moderate to extreme. A person with significant depression has a low mood, anhedonia, poor cognition, sleep, appetite, and daily activity issues for over fourteen days.

Dysthymia (minor depression): It's a nominal kind of persistent depression in which a person is depressed for minimum two years. Even though the dysthymia symptoms are not as extreme as those experienced by people suffering from mild depression, Dysthymia patients are at risk for secondary major depressive episodes. Dysthymia is a mild form of depression that lasts at least two years.

Bipolar Depression: It's a disorder in which depressed episodes alternate with mania or hypomania. Bipolar depressive disorder was the previous name for it. While depression is now classed as a distinct diagnosis, there is still debate because persons diagnosed with severe depression frequently exhibit hypomania symptoms, implying that mood disorders are linked. Cyclothermania is a moderate type of bipolar disorder marked by periodic hypomania and depression episodes.

Melancholic Depression: The inability to respond to pleasurable stimuli, a low mood quality more apparent than sadness and loss, a deteriorating of side effects in the first part of the day hours, early morning wakeup, psychomotor slowness, too much weight, or excessive guilt are all markers of it.

Atypical Depression: It's been connected to mood swings, hypersomnia, more hunger and fatten body weight, leaden paralysis (heaviness of the arms or legs), and considerable social dysfunction as a consequence of hypersensitivity to interpersonal rejection.

Catatonic Depression: This is an atypical and extreme type of major depression characterized by motor behaviour disturbances and other symptoms. The individual is quiet and more or less stupor and remains stationary or moves about aimlessly or maybe bizarrely. Unipolar depression is diagnosed when a person has depression and no mania. Bipolar disorder is diagnosed if depressive or hypomanic episodes are present.

Symptoms of Depression : (Ashok Kumar et al., 2014; Ashwani & Preeti, 2012; Sharan, 2010)
The significant symptoms of depression are:-

- Loss of delight or interest in your likes.
- Gaining or losing weight.
- Experiencing difficulty dozing or feeling tired during the day Feeling fretful and restless, or in any case languid and eased back truly or intellectually.
- Being depleted and depleted of energy
- Feeling useless or sorry.
- Experiencing issues thinking or deciding.
- Self-destructive considerations.

Cause of Depression: (Beirão et al., 2020; RICHELSON, 1994; Sharan, 2010)

Genetic

- It can run in families.
- Depression, on the other hand, can strike persons who have no familial history of depression.

Environmental: A significant misfortune, muddled relationship, monetary issue, or any unpleasant (unwanted or even wanted) change in life examples can trigger a burdensome scene.

Physical Illness: Genuine inconveniences, for example -cancer, some disorders, e.g. Cushing's syndrome etc.

Drug-induced: E.g. β-blockers and corticosteroids.

Hormonal changes: Depression cause at Postmenopausal, post-partum depression.

Behavior Characteristics: Low confidence, critical perspective, low-stress resilience.

Biological: Ebb and flow research investigates issues with mind work in the accompanying regions: The limbic framework, neurotransmitter and neurons, chemicals, and the endocrine framework are engaged with the limbic framework.

Antidepressants

Antidepressants are medications that affect the brain to balance the chemical of neurotransmitters, thereby reducing the depression symptoms. A chemical imbalance is causing the shift in mood and behaviour. Neurotransmitters connect neurons in the brain and allow them to communicate with one another. Nerve cells have vesicles where neurotransmitters are stored. Reuptake is a marvel wherein neurotransmitters like serotonin, dopamine, and noradrenaline or norepinephrine are delivered by the exonic end of one nerve and got by the other. Antidepressants increase the concentration of a specific neurotransmitter surrounding nerves in the brain by blocking neurotransmitter reuptake through certain receptors. SSRIs (selective serotonin reuptake inhibitors) are an example of an antidepressant. A serotonin reuptake inhibitor changes the amount of serotonin in the brain. Antidepressants can help with the symptoms of depression, but they often have side effects. They're used to treat nervousness, anxiety, depression, manic-depressive disorders, OCD, childhood bedwetting, disorder, diabetic peripheral neuropathy pain, major depressive and post-traumatic stress disorder, among others and some in fibromyalgia, flashes, hyperhidrosis (excess sweating) caused due to drug-induced, symptoms of premenstrual ,persistent hives (allergic reaction) , Nervosa, binge eating disorder ,itching and others variety of symptoms. (Ashwani & Preeti, 2012; Konduru, 2014).

Types of Antidepressants: (Jordan Moraczewski; Kapil K. Aedma., 2021; Mayoclinic, 2019c, 2019a, 2019b)

"Selective serotonin-reuptake inhibitors (SSRIs)": Eg. "Lexapro", "Prozac", "Zoloft"
Mechanism of Action: Antidepressants like selective serotonin reuptake inhibitors (SSRIs) mechanism by escalating levels of serotonin in the brain. The chemical messenger (neurotransmitter) called serotonin that aids in communicating cells of nerve situated in the brain (neurons). Serotonin is prevented by SSRIs from being reabsorbed (reuptake) into neurons. Thus, incresing the quantityt of serotonin available improves message transmission between the neurons.

Side Effects: Although some people may not have any adverse effects, all SSRIs are thought to function similarly and can induce comparable adverse effects. Many negative symptoms may fade within a few weeks of treatment, while others may prompt you and your doctor to switch medications.
SSRIs may cause the following adverse effects, among others:

- Nausea, vomiting, or diarrhoea are all symptoms of a stomach bug.
- Drowsiness
- Mouth is parched
- Insomnia
- Nervousness, agitation, or restlessness
- Feeling dizzy
- "Reduced sexual desire", "trouble reaching orgasm", or lack of ability to keep an erection are all examples of sexual issues (erectile dysfunction)
- It affects appetite, resulting in weight loss or growth.

Tricyclic antidepressants (TCAs): Eg. Norpramin and Pamelor

Mechanism of Action: Tricyclic antidepressants function through 5 types of different neurotransmitter pathways to create their effects. They obstruct the resorption of serotonin and norepinephrine in presynaptic terminals, results in increasing levels of these neurotransmitters in the synaptic cleft. The more significant amounts of norepinephrine and serotonin in the synapse are expected to have an anti-depressive effect. It is also be used as competitive antagonists on post-synaptic alpha cholinergic (alpha1 and alpha2),histaminergic receptors (H1) and muscarinic .(Jordan Moraczewski; Kapil K. Aedma., 2021)

Side Effects: TCAs have a wide range of receptor affinity, which can result in a variety of side effects. Constipation, drowsiness, and xerostomia are the most prevalent side effects. It can cause constipation, impaired vision, disorientation ,xerostomia, urine retention, and tachycardia by blocking cholinergic receptors. In addition, it can produce orthostatic hypotension and dizziness by blocking alpha-1 adrenergic receptors. Sedation, increased hunger, increases weight, and bewilderment are all possible side effects of TCA-induced histamine blocking (H1).TCAs may cause cardiovascular difficulties such as arrhythmias like ventricular fibrillation, QTc prolongation, and sudden cardiac death in patients if there is pre-existing ischemic heart disease. As a result, a patient's heart condition must be examined before TCA is prescribed. TCAs have been shown to increase seizures in people with epilepsy. Thus they should be used with caution in this group. In addition, TCAs may produce minor elevations in liver enzymes; nevertheless, acute hepatitis is rarely linked to the use of tricyclic antidepressants.

Atypical Antidepressant: Eg. Wellbutrin

Mechanism of Action: "Atypical antidepressants work by changing chemical messengers (neurotransmitters) that let brain cells interact. Atypical antidepressants, like most antidepressants, work to treat depression by affecting brain chemical changes and communication in brain nerve cell circuits known to influence mood. Atypical antidepressants affect the levels of dopamine, serotonin, and norepinephrine, among other neurotransmitters".

Side Effects: Antidepressants, including atypical antidepressants, may have side effects; however, few people may not understand. Few side symptoms may fade over time, while others may prompt you and your doctor to switch medications.

- Dry mouth, dizziness, and light-headedness are common adverse effects of atypical antidepressants.
- While some anti-depressants can assist you sleepwell and are best if taken at night, others can make you sleepless.
- Some antidepressants might cause constipation, while others can make you more likely to get diarrhoea.
- Some antidepressants might promote weight gain by increasing your appetite, while others can cause nausea.
- Few antidepressants have more ability to cause sexual adverse effects than others.

Monoamine Oxidase Inhibitors (MAOIs): Eg. Isocarboxazid, Phenelzine and Selegiline

Mechanism of Action: Antidepressants are known as MAOIs, change the chemical messengers (neurotransmitters) that cooperate between brain cells. MAOIs, like most antidepressants, function by altering brain chemistry, which is linked to depression. For example, an enzyme Monoamine oxidase that removes the serotonin, neurotransmitters

norepinephrine, and dopamine from the brain. MAOIs stop this, allowing more of these brain chemicals to cause depression-related alterations in cells and circuits. MAOIs have adverse effects via affecting other neurotransmitters in the digestive system and brain. Other than depression, "MAOIs" is occasionally used to treat illnesses, including Parkinson's disease.

Side Effects: MAOIs are most commonly used when other antidepressants have failed due to adverse effects and safety concerns. The following are the most common MAOI side effects:

- Mouth is parched
- Nausea, diarrhoea, or constipation are all symptoms of a stomach bug.
- Pain in the head
- Drowsiness
- Trouble sleeping.
- Light-headedness or dizziness
- Skin reaction.

Role of Herbal Drugs in Depression

Plants and their derivatives are a significant source of nutrition in our lives. Still, they may also be utilized and are increasingly being employed to treat anxiety, mood disorders, and sleep disturbances. People are turning to herbal remedies as a type of treatment, and the standard pharmaceuticals used to treat these ailments. This is because there have been fewer reports of severe side effects, and these herbal treatments are generally thought to be safe and effective. Because of the popularity of herbal remedies, individuals are contacting herbalists, naturopaths, and other healers in addition to physicians. Mood problems are typically treated with herbal drugs for example "Hypericum perforatum L. (St. John's wort and kava)". Because plant metabolites attach to neurotransmitters or neuromodulator receptors, these drugs affect neuronal communication. Some even disrupt neurotransmitter production and function in general. There is, however, a scarcity of data on the use of herbal medicines and cures in psychiatry. Apart from the antidepressants that have been used for centuries, this literature describes many herbal drugs that can be utilized for mood disorders. The primary mechanism of action is to modify neurotransmitter synthesis and function by binding definite plant metabolites to "neurotransmitter/neuromodulator receptors" and modulating neuronal communication. They've also been discovered to have a stimulating or sedating effect on the central nervous system.(Islam, 2015; Kamalipour et al., 2008; Patel & De Sousa, 2014).

Some herbal Antidepressants are-

***Lavendula* spp. (Lavender):** "GABA modulation is the principal effect of lavender. When taken alone, lavender is less effective. It promotes monoamine reuptake inhibition (dopamine, norepinephrine and serotonin). It's also a GABA-á agonist and an NMDA receptor antagonist. Saffron, as compared to Imipramine and fluoxetine, is more successful in treating depression. Nausea, Anxiety, dyspepsia, tachycardia and changes in appetite are some of the side effects. It is less effective than Imipramine, but it is more effective than Imipramine alone, signifying a synergistic effect when used together". (Patel & De Sousa, 2014).

***Rhodiola Rosea* L. (Roseroot):** Stress-induced protein kinases ,Monoamine oxidase A ,Cortisol, nitric oxides, and are all inhibited by it. It has been found in animal models to normalize 5-HT and have anti-stress properties. Roseroot has also been proven to have anti-fatigue properties. This feature, in combination with monoamine regulation, can be utilized to treat monopolar depression. (Patel & De Sousa, 2014).

CONCLUSION

Depression is a widespread mental illness that causes significant human suffering like psychological disorders. Depression in adolescents is more complicated than in older people, but early identification and proper treatment can save the patients from causing more damages. There are many antidepressants drugs available in the market are

"Selective serotonin-reuptake inhibitors (SSRIs)": Eg. Lexapro, Prozac, Zoloft, Tricyclic antidepressants (TCAs): Eg. Norpramin and Pamelor, Atypical Antidepressant: Eg. Wellbutrine, Monoamine Oxidase Inhibitors (MAOIs): Eg. Marplan and Nardil, although all these drugs can cure a patient from depression, all these drugs have got various side effects also. Therefore, all these drugs must be taken after consulting the proper doctor according to the prescribed quantity.

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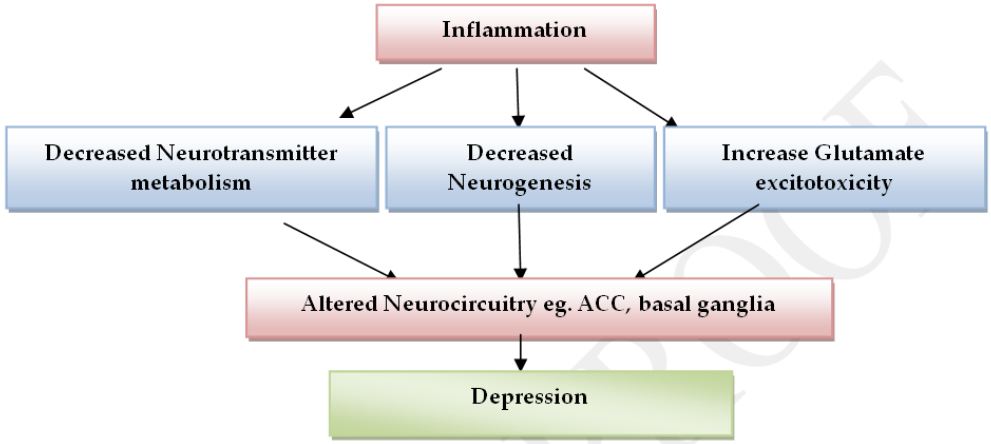

Fig 1: Pathophysiology of Depression

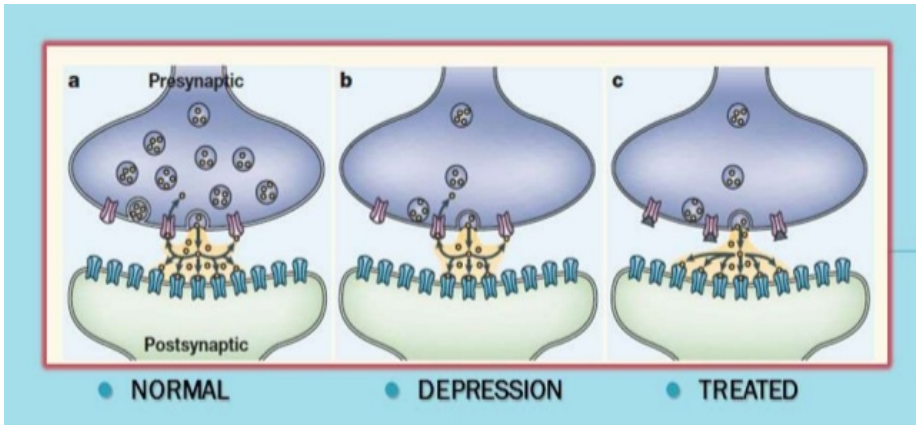

Fig 2: Normal, Depression and Treated mechanism

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RESEARCH ARTICLE

Grass-inspired Active Porous Carbons for Electrochemical Capacitors: A Comparative Study

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ABSTRACT

Development of affordable, sustainable and renewable energy devices with less environment taxing components is the object of intense research among energy advocates. Accordingly, this article aims to advocate an environment waste-to-energy concept by utilizing two grasses *viz., Aristida setacea* and *Thysanolaena latifolia* derived H_2SO_4 activated porous carbon (named ASAC & TLAC) as electrodes for electrochemical capacitors or pseudocapacitors, the popular and advancing energy storage technology. Further, the objective of the study is to compare the specific capacitance and to propose explanation for the origin and the variation observed in the capacitance. X-ray analysis and scanning electron microscopy confirmed the formation of graphitic layer and the surface morphology respectively. FTIR spectrum shows the presence of O, N &/or S heteroatoms bonded as organic functional groups that confers pseudocapacitance via redox reactions. Surface area, pore volume and pore size distribution suggest favorable physical features in the samples suggesting good electrochemical cyclability. Specific capacitance at the end of 500th cycle is 356 F/g for ASAC and 424 F/g for TLAC in 1M H_2SO_4 electrolyte. Since TLAC alone has S-containing groups while ASAC does not, the authors put forth that the presence of even a trace of sulphur is very crucial in enhancing the total capacitance thus confirming the important contribution from sulphur. Mechanisms for the improved capacitance are discussed. TLAC emerges as a promising electrode material for supercapacitor applications yet both ACs are bestowed with superior physical and electrochemical features over many reported phytomass derived chemically activated carbons. The studies distinctly show that the above grasses are a new biomass source of carbonaceous materials for high-performing psuedocapacitors identified under circular bioeconomy.

Keywords: Activated carbon; phytomass; electrochemical capacitors; pseudocapacitance; supercapacitor; circular bioeconomy

INTRODUCTION

Biomass, phytomass, activated carbon and green energy are interconnected in realizing sustainability and could be attained only through circular bioeconomy. Needless to mention that energy and its uninterrupted access is the central for any nation that claims to be socio-economically progressed. Obviously, renewable energy has always been the focal point among energy advocates with a special attention on creating a less-polluted and stress-free Earth. But the *status quo* is that the natural fuels and energy resources are tapped at a very distressing rate. Thus for resolving the ever-escalating energy demand and for a sustainable future, there is a dire need for smart, efficient, reliable and affordable green energy conversion and storage gadgets. Falling in this line are the batteries, fuel cells and capacitors which are, by and large, regarded as clean energy devices. To be more specific, supercapacitors or ultracapacitors, which are introduced a couple of decades ago are the upgraded versions of the traditional capacitors and are the typical high energy storage devices even superior to batteries [1]. Supercapacitors can accumulate and provide energy at a very fast rate by delivering a very high current in a short time and thus their energy performance can be matched for ensuring reliable applications.

Recent high performing supercapacitors use porous activated carbons (ACs) as electrodes [2] and one of the best resources for generating ACs powders and that too in large mass are the renewables or plant biomass (phytomass) wastes [3]. So any inexpensive phytomass with high carbon content, low inorganics and ash may serve as raw materials for the production of ACs [4, 5]. Because of their varieties, abundance and high carbon content, phytomass can be turned into valued-added and biodegradable carbon substances. Thus it is needless to mention that ACs are indispensable engineering material lending itself in multifarious science and technological fields due to their cost, extended porosity, physical and chemical stability and commercial up-scalability, in addition to the varieties of phytomass precursors available for its production.

It is known that biomass, after its life would become rejects causing disposal problems. Mostly, discarded phytomass wastes pose environmental pollution issues as it takes time to decay and before they get decomposed microbes multiply by consuming minerals, sugars, proteins and water contents. On the other hand, incinerating solid wastes would emit toxic gases whose effluence may even be higher than that caused from organics. Consequently, consuming these wastes for conversion into ACs would add economic value, help reduce the cost of waste disposal and most importantly provide a potentially inexpensive alternative to the existing cost-prohibitive commercial AC powders.

Traditionally, ACs can be produced by oxygen-free carbonization of some carbonaceous rich feedstock, such as grass, wood, nutshells, and coal etc [6]. Therefore, in recent years there is a huge hype in the research on the production of ACs from domestic, industrial and agricultural byproduct discards/refuses and has become a highly attractive research theme in today's science of advanced materials. It is noteworthy that the type of phytomass precursors along with the activation methodologies, activating chemicals and process parameters influence the properties and ultimately their applications.

Over the past few years, numerous studies have been accomplished with the precursor materials for producing ACs from biomass for the application as electrodes in supercapacitors. Date stones [7], waste coffee beans [8], sunflower seed shells [9], corn grains [10], leather waste [11], Orange peel [12], eucalyptus bark [13], bean seed pods [14], groundnut shells [15] are the representative reported research efforts that the authors of the present communication wish to quote here for the benefit of the readers. The present investigation also concerns with the derivation of ACs by chemical activation of two grasses for the supercapacitor electrode applications; however the studies extend further up to compare their capacitive performance in acid electrolyte. Process parameters, physico-chemical and electrochemical characterization of the resulting ACs are examined and compared in this paper to meet the objective of the work setting an example for circular bioeconomy in energy sustainability. An attempt has also been made to

interpret the differences that might be observed in the electrochemical features of the two grass derived ACs (GACs). Whenever a novel carbon source is identified for a particular application, fundamental work must be carried out to characterize the samples so that we can decide if its properties fit best for the prescribed use. Thus the present investigation has been planned systematically for the supercapacitor/pseudocapacitor electrode application.

ACs are characterized by high specific surface area >1000m^2/g, large porosity and well-developed pore structure consisting of micro-, meso- and macropores and also has surface organic functional moieties such as amino [16], carboxyl, carbonyl, hydroxyl [17, 18], sulphoxide [19] etc. Hence carbon products obtained after activation of the phytomass precursors are inherently rich in heteroatoms such as O, N & S. These heteroatoms derived from the raw material involve in the development of AC during carbonization process or they may be chemically bonded to the surface during activation [20]. Literature shows that the heteroatoms are bonded to carbon atoms of the edges and corners of the aromatic sheets or to the carbon atoms at defect positions to form carbon-oxygen, carbon-hydrogen, carbon-sulfur, carbon-nitrogen surface compounds, known as surface groups or surface complexes [21, 22]. These heteroatoms aid electron transfer (called the Faradaic redox reactions) due to their electron donating ability, increase the conductivity and improves the wettability of the AC and therefore can exhibit excellent electrochemical performance through pseudocapacitance [23, 24]. It is interesting to know that carbons with heteroatoms like O & N would lead to 5-10% increase in the total capacitance when compared to carbon having no heteroatoms [25]. Since the type and nature of the heteroatoms and porosity vary with the source and characteristics of the biomass precursors, studies on ACs derived from two biomass would throw hints whether or not these heteroatoms act one over the other in influencing the electrochemical (capacitive) features of the biomass-derived carbons. Consequently, with the above perspectives the present work provides a comparative study of two grasses activated carbons (GACs) to evolve an effective alternative to the carbon-based electrodes for supercapacitors. Hence, in view of the promise of phytomass as a natural source and resource for high quality carbon production through circular bioeconomy pathway for green energy the above work has been undertaken.

EXPERIMENTAL METHODS

MATERIALS AND INSTRUMENTS

Aristida setacea – AS and *Thysanolaena latifolia* – TL are the two grass biomass precursors used for the preparation of the GAC powders. While AS was collected near the roadside of Dindigul-Kumily Highway, TL was collected in the interior of Adukkam hills, Tamil Nadu, India, during autumn. For the process, only grass blades of the biomass were used. Sulphuric acid-98% from Merck Ltd, carbon black, poly(vinylidene difluoride) (PVdF, MW = 450,000 g/mol), and N-methyl 2-pyrrolidone (NMP) were all purchased from Sigma-Aldrich, Stainless Steel-302 was used for fabricating electrodes on which slurry of GACs was loaded. The image of the two grasses is given in Figure 1.

Preparation of activated carbons from grasses (ASAC & TLAC)

In a typical procedure of synthesizing GACs, blades of the two grasses were separated from the plants, thrice washed rigorously with triply distilled water and then dried under shade for 3 days and powdered to 250 mesh. For activation, conc. H_2SO_4 was added to the samples in the ratio of 1:1 (v/w) in a well cooled glass beaker and mixed well with a glass rod. Charring accompanied copious fumes within a few minutes of adding the acid. After cooling, the charred mass was subjected to carbonization at 800 ºC for 1 h at 5 °C/min ramp rate under N_2 atmosphere (with 5 mL/min flow rate) in a specially designed electric furnace with inner quartz compartment. Cooling was also done at the same ramp rate. The resulting black lump was crushed and washed with triply distilled water to remove activating agent. pH neutrality of the washings ensures thorough washing of the samples. Finally, the black powder was dried in an oven, pulverized and was used for further characterization and electrochemical investigation. The black powders obtained were named as *Aristida setacea* activated carbon and *Thysanolaena latifolia* activated carbon and designated respectively as ASAC & TLAC.

Yield and burn-off

The % yield of the AC is the ratio of the mass of the AC (m_{ac}) to that of the dry and powdered biomass (m_d) and is given by the following formula, % yield = (m_{ac}/m_d) × 100%, while the burn-off is the weight loss percentage due to the activation step.

Instrumentation

Vario ELIII CHNS/O Analyzer was used to carry out the elemental analysis of the GACs. X'Pert Pro X-ray diffractometer with CuK_α radiation source was used to record X-ray diffraction patterns. X-ray intensity was measured in the range of $10^o<2\theta<80^o$ with a scan rate of 2^o/min. The surface morphology was studied on S-3000H model microscope (SEM). The samples surface was degassed using Ar gas and sputtered with gold before scanning. Functional groups on the surface of the GACs were ascertained using FTIR spectrometer (Model # JASCO FTIR - 5300) in the range from 4000 to 400 cm^{-1}. The pore structure of the GACs was characterized by N_2 sorption at 77 K using Micromeritics ASAP 2020 instrument (Micromeritics, USA). BET (Brunauer, Emmet and Teller) method was followed to calculate the surface area of the GACs. CH Instrument Model # CHI660a was used for cyclic voltammetric, electrochemical impedance spectroscopic (EIS) and galvanostatic charge-discharge studies.

Electrochemical measurements

For the electrochemical studies in a three electrode system, electrodes were prepared on SS rods of 8cm length and circular ends of $1cm^2$ area. Electrode slurry was prepared by mixing the GAC powder, commercial carbon powder and PVdF binder in the % weight ratio 88:10:2 with N-methyl 2 pyrrolidone as the solvent and was applied to the circular end of the SS rods. The electrodes were dried at $80^\circ C$ for 1 h in vacuum oven. Heat shrinkable sleeve was used to mask rest of the electrode portion, leaving a small area at the top for establishing electrical connection with the electrochemical workstation. SS rods coated with ASAC & TLAC acted as the working electrode, platinum strip as the counter, and Saturated Calomel Electrode as the reference electrode. 25 ml of 1M H_2SO_4 served as the electrolyte. The electrolyte was degassed with purified N_2 gas for 10 min before measurements and continued degassing during measurements. The solution temperature was maintained at 28 ^oC by a water-based thermostat.

RESULTS AND DISCUSSION

Yield and burn-off

The yield was calculated to be 61% and burn-off to be 39% for ASAC and 68% yield and 32% burn-off for TLAC. It is understood that the % yield of the AC from the raw material would decrease and the % burn off would tend to increase with temperature. The % yield is quite significant such that the activation methodology adopted here is considered to be reliable and can be extended to any phytomass.

Elemental analysis of GACs

The type and % of the chemical constituents are expected to influence the electrochemical parameters and hence ultimate elemental analysis was carried out on the samples. While ASAC has 28.41% N, 64.05% C, 1.254% H, and 6.286% O, which was found by difference, TLAC was found to contain 15.66 % N, 62.14% C, 4.388 % H, 0.653% S & 17.159% O. Results of the elemental analysis have been compared in Table 1. It is well known that all these elements are coordinated in the form of many organic functional moieties, as will be discussed under FTIR results. % C in both the samples is approximately the same and % N is ~ 2 times more in ASAC. Interestingly, in ASAC, no sulphur could be traced; nevertheless, a low sulphur content of 0.65% in TLAC cannot also be ignored and may be significant in explaining any difference observed in the electrochemical performance in the two ACs studied. Owing to that reason, qualitative as well as quantitative studies on the hetero elements in ACs may prove an interesting and novel research topic in designing better performing AC. The source of the hetero elements containing organic functional groups is obviously due to various active principles like lignin, flavanoids, saponins, terpenoids etc., present in ASAC [26] and also adenosine, uridine, tryptophan, hydroxy methyl glutaryl CoA present in TLAC phytomass [27,

28]. Reports say that O-containing groups tend to enhance the polarity of the carbon thus rendering it hydrophilic [29] and support redox reactions [30]. We have also reports stating that O- & N-rich carbon influences the specific capacitance in an opposite manner that, O-rich activated carbon offers slightly lower capacitance, the reason being that the O-containing groups present on the carbon surface hinder the diffusion of the electrolyte ions into the pores of carbon electrode surface and N in the sample improves the capacitive behavior [31, 32]. Furthermore, the presence of S favors adsorption as well as transfer of electrolyte ions [33, 34] leading to the conclusion that the presence of hetero elements improves wettability and many other attributes of the carbon electrode, which in turn would be responsible for the overall electrochemical performance [35].

Powder X-ray diffraction (PXRD) studies

Fig. 2(a) and (b) respectively are the XRD pattern of ASAC & TLAC. The peak positions were measured and 'd' spacing was calculated using Bragg's equation. It can be seen from Figure 2 that the XRD patterns are similar excepting for the intensity of the broad reflection between 20º & 30º and thereafter the patterns overlap. Obviously this peak is the characteristic of carbon and was indexed as (002) peak. The nature of this peak substantiates the amorphous and graphitization features of both the samples thereby confirming the disordered nature also [36]. It is known from the work of Zhang et. al. [37] with pinecone hull activated carbon that the FWHM and d_{002} plane is a measure of degree of graphitization. Again as stated by Zhang et. al. [37] in the same work, the emergence of graphitic structures in our carbon samples also may apparently be due to the breaking of chemical bonds of the organic constituents contained in the grasses selected. The interplanar space (d_{002}) computed for ASAC is 3.89Å and TLAC is 3.96Å, a value higher than that estimated for graphite (3.354Å), which again proves disorderliness in our GACs [38]. Besides, as the d_{002} value is higher for TLAC than ASAC, it may be concluded that TLAC is more amorphous than ASAC, bestowing enormous electroactivity to TLAC [2], as affirmed from electrochemical studies also.

Scanning electron microscopy studies

In Figure 3 a-d, SEM images of ASAC & TLAC at two different magnifications have been shown from which the surface morphology can be comprehended. The SEM of ASAC shows several duct or tunnel like striated structures formed throughout the carbon surface, as if lacking porosity. On the other hand, SEM of TLAC shows numerous folds and pits [39] explaining drastic surface damage of TL than AS due to the chemical activation with conc.H_2SO_4 finally leaving behind fissures and pores on the surface of the TLAC. Moreover, the micrograph of TLAC shows a continuous network of pores and at some places collapsed porous structure is also pronounced. Because of the presence of continuous network of pores, an increase in the surface area, number of active sites and pore volume in TLAC is expected, which may contribute considerably towards electrochemical performance.

Fourier Transform Infrared (FTIR) vibrational studies

FTIR vibrational studies are undertaken for the qualitative characterization of the various functional groups present on the GACs and are presented in Figure 4(a) & (b). Inset in Figure 4 represents the simplest model of the various organic functional groups that are presumed to be on the surface of the AC. It is to be understood that the chemical activation followed by thermal processing of biomass into AC is associated with a loss of functionalities, loss of carbohydrates and retention of aromatics and so we cannot expect the same organic constituents as that of the precursors. FTIR spectra shows the presence of alkyl groups, carbonyls, amides, aldehydes, methyl groups, amines, thiols, sulphoxides and sulphide bonds on the surface of the GACs and assignments of various FTIR signatures are listed out in Table 2.

The isolated –OH functional group is observed at 3784cm^{-1} for ASAC and 3788cm^{-1} for TLAC. The characteristic peak around 3474cm^{-1} for ASAC and 3450cm^{-1} for TLAC indicates the presence of -NH stretches of the amino group [40]. The peak around 3148cm^{-1} and 2926 cm^{-1} for ASAC and 3059cm^{-1} for TLAC in the samples endorses the presence of aliphatic C–H bond corresponding to the methyl and methylene group [41]. A peak at 2860cm^{-1} for ASAC and 2829cm^{-1} for TLAC shows the presence of stretches of aldehydes. A band at 2579cm^{-1} for TLAC shows the presence of

sulphur compounds [42]. A band at 2268cm^{-1} for ASAC and 2272cm^{-1} for TLAC shows the stretching of amide. A characteristic peak observed at 1591cm^{-1} for ASAC and 1597cm^{-1} for TLAC corresponds to N-H stretching vibration. A peak at 1182cm^{-1} corresponds to C-O stretching for ASAC. A peak at 1099cm^{-1} for TLAC shows stretching vibration of organic sulphoxides. The band around 1089cm^{-1} is attributable to the C-O-C stretching vibration in ASAC sample. The band at 783cm^{-1} is associated with C-H stretching and a peak at 597cm^{-1} shows -S-H vibration in TLAC [23]. Thus FTIR spectroscopy clearly identifies a mixture of functionalities in both samples and as already mentioned, the additional sulphur containing groups in TLAC is likely to play an interesting and positive role in determining/influencing the electrochemical behavior ultimately.

Pore texture and surface area measurements of GAC electrodes by BET method

It is clear from a number of reports on ACs that electrochemical performance of capacitors essentially depends on the surface properties and pore nature of the carbons. N_2 adsorption/desorption studies indicate the types of pores developed in ACs and hence the same has been undertaken for GACs. Presented in Figures 5(a) & (b) are the N_2 isotherms of ASAC & TLAC respectively. IUPAC has classified the adsorption isotherms into six types as type I to type VI based on the shapes of the isotherms obtained at different relative pressures (p/p_o). Each type signifies the porous or non-porous behavior [11]. According to the definition by IUPAC, the adsorbent pores are classified into three groups: micropores (diameter < 2 nm), mesopores (2–50 nm) and macropores (>50 nm). In general, micropores account for over 95% of the total surface area of common ACs [43].

Based on the foregoing discussion, the isotherm of ASAC has been identified to possess type I characteristics with a broad knee within low relative pressure range, reflecting high microporosity in the sample [44, 45]. The isotherm features a plateau indicating that the adsorption might have been stopped. The quick saturation is due to the proximity of the pore walls so that the sample contains mainly micropores. For TLAC, the isotherm was found to be of type IV [45] and it is observed that the linear branch of the curve is not horizontal and in fact the knee is more rounded and exhibits hysteresis at p/p_o = 0.6. Hence for TLAC, where the isotherm shows a broad knee and hysteresis loop should possess micropores as well as mesopores, according to the IUPAC classification. In general, type IV isotherm with hysteresis reflects mesopores which might have been produced by capillary evaporation during desorption [44, 46]. This observation infers that chemical activation of phytomass sources is a successful method for preparing carbon powders with mesopores.

The Brunauer–Emmett–Teller (BET) surface area (S_{BET}) of GACs was calculated using the N_2 adsorption data within the relative pressure (p/p_o) of 0.01 to 1. The total pore volume (V_{total}) and micropore volume (V_{micro}) was determined by t-plot method. The mesopore volume (V_{meso}) was calculated by subtracting the V_{micro} from the V_{total} [47]. These values along with the average pore width (4V/A) are compared in table 3. It is clear from table 3 that the pore structures evolved in GACs is a combination of meso and micropores, and that the mesopore volume of TLAC accounts for 67% of the total pore volume, which might be due to the slow transformation of micropores into mesopores during acid activation and amongst the two GACs studied, pore width of TLAC is found to be favorably larger than ASAC. These results make obvious that GACs possess high specific surface area and large mesoporosity with favorable pore width which may be advantageous for electrodes in electrochemical applications. It is also apparent that S_{BET} of GACs lie within the range of many reported biomass-derived activated carbons. As reiterated, carbons produced from biomass precursors possess high surface area, mesopore volume and are rich in heteroatoms are helpful in creating enormous electrochemically accessible active sites, thereby conferring excellent electrochemical performance [24, 19]. Based on the above discussion, TLAC might be performing comparatively better than ASAC.

Electrochemical studies

Evaluation of capacitive behavior of GACs from impedance data

Electrochemical impedance spectroscopy (EIS) is a versatile tool for evaluating many electrochemical parameters of the electroactive materials by studying the effect of electrode//electrolyte interaction, charge transfer and ionic resistance. Consequently, energy researchers take advantage of the technique in estimating the specific capacitance of supercapacitors. As far as the EIS is concerned, Nyquist plots are the common representation of a. c. impedance. In general, the total impedance in the Nyquist plots may be sectioned into three regions according to a. c. frequency scanned (from milli to kilo Hertz) viz., (i) electrolyte solution resistance (R_s), which show up at high frequency region and depends upon the nature of the electrolyte used (ii) interfacial charge transfer resistance (R_{ct}) between the electrode and the electrolyte, which can be identified by semicircle(s) at the middle frequency region and plays an important role in the electrochemistry of materials and (iii) a straight line termed as the Warburg impedance (W) that occurs at low frequency region due to diffusion of ions into the intra-particle micropores of the electrode. Further, R_{ct} involves (i) ionic resistance, which is the resistance due to the mobility of the electrolyte ions inside the pores of the electrode and (ii) the electronic resistance, is due to intrinsic resistance of the electrode material and the contact resistance arising between the active layer of the electrode material and the metal current collector. Consequently, the following information can be derived.

(i) Smaller semi-circle radius would mean a lower R_{ct}.
(ii) Charge transfer is the result of Faradaic processes like redox reactions that may occur at electrode/electrolyte interface and the result is R_{ct}.
(iii) High ionic mobility of electrolyte ions would decrease the ionic resistance and increases with the pore size of the electrode.
(iv) Existence of mesopores coupled with high electrical conductivity (low impedance), in addition to physical features, should be considered for developing electrode materials for energy devices.

Hence EIS study is conducted on the GAC electrodes in 1M H_2SO_4 electrolyte and is presented in Figure 6. A single semi-circle for ASAC electrode indicates that R_{ct} related to Faradaic process occurring at the ASAC electrode//electrolyte interface. The authors speculate a very low R_{ct} in the case of TLAC as no semi-circle was observed. But for both the electrodes, a straight line segment with a slope of approximately 45° in the intermediate frequency is observed representing a combination of resistive and capacitive behaviors due to the ions penetrating or diffusing into the pores of the electrodes. The electrolyte ions penetration and charges accumulated at the available internal surface of porous electrodes are known to be dependent on the AC preparation procedures.

From Nyquist plots, the specific capacitance (C_{sp}) of GAC electrodes in acid electrolyte was calculated using the formula $C = 1/(2\pi fZ''m)$, where f is the frequency (1mHz), Z" is imaginary impedence at f and m is the mass of the carbon material respectively [48] and has been tabulated in table 4 along with R_s, R_{ct} and C_{sp} derived on the basis of the Randles equivalent circuit. From the results of EIS studies, it can be inferred that diffusion barriers and resistance in the interior of the electrodes of ASAC is significant than TLAC and in acid electrolyte, C_{sp} is higher for TLAC than ASAC, which is due to a very low R_{ct}. Hence TLAC electrode materializes as a good capacitor electrode. The above conclusion for TLAC is also based on the facts that good ion transport, diffusion, conductive properties, presence of various heteroatoms and favorable electrode features such as enhanced surface area and mesopore volume, as discussed in the preceding sections. Readers of this article may agree that the C_{sp} for GACs calculated from Nyquist plots are superior to the values obtained from many biomass-derived carbons reported [49].

So to conclude EIS studies, both GAC electrodes in 1M H_2SO_4 exhibited the behavior of a capacitor with low internal resistance, as demonstrated by a nearly vertical line in the mid to low frequency range, thus indicating excellent electrolyte penetration/diffusion into the GAC electrodes, augmented by higher surface area and mesopore development [50, 51].

Cyclic voltammetric (CV) studies with GAC electrodes

Capacitive behavior of the GAC electrodes have been explored through CV studies in 1M H_2SO_4 electrolyte. CV of the ASAC & TLAC electrodes with scan rates from 10-50mV/s at the end of the 5th cycle is illustrated in Figure 7 (a & b) respectively. CVs of GACs in acid electrolyte exhibit symmetric responses in their positive as well as negative scans and the integrated charges stored in the positive scans could be delivered during the negative scans and consequently good electrochemical behavior of GAC electrodes is proved. It can also be inferred that the current rapidly reach plateau when the scan is reversed, especially for TLAC. This illustrates lower ESR in the TLAC electrode in the acid electrolyte chosen. It is well known that lower ESR is one of the prerequisites for higher capacitance retention at high currents and also the power capability of any electrochemical gadget [52, 53]. Further, the observed capacitive currents of TLAC in 1M H_2SO_4 is at least two times higher than that observed for ASAC. This may be explained by the fact that H^+ ions of the acid electrolyte has excellent mobility and electrochemically active to access the entire surface area of TLAC (because of high mesoporosity) over ASAC leading to quick charge distribution in TLAC. In Figure 7, CV of ASAC & TLAC electrodes recorded at 10-50mV/s at the end of the 5th cycle is shown wherein distorted/quasi-rectangular shape with significant redox peaks are obvious, which is entirely different from that for an ideal EDLCs, where the shape is a perfect rectangle. The peaks presumably are due to the surface redox reactions occurring with the N-, O (&/or S)-containing organic functionalities and this observation strongly confirms the contribution of enormous Faradaic pseudocapacitance [54, 55] combined with electrochemical double-layer charging capacitance (EDLC).

The reactivity of the heteroelements containing groups on carbon surface in the presence of acid electrolyte is largely due to the difference in electronegativity between heteroatoms and carbon or hydrogen atoms present on the carbon surface. In other words, heteroatoms acquire partial negative charge, becoming electron rich; meanwhile carbon atoms become electron deficient, acquiring a partial positive charge due to the difference in electronegativity. The presence of heteroatoms containing groups on the surface of the GACs would therefore enhance the surface polarity and makes it more hydrophilic. H_2SO_4, the electrolyte used in the present investigation, is a highly polar compound, has a low affinity for carbon thus interacts strongly with heteroatom containing surface groups. So having these understanding in view as well, let us now discuss the mechanism by which the heteroatoms contribute towards the origin of pseudo capacitance in the biomass-derived ACs.

Principally, oxygen-containing functional groups are classified as, phenol group (C-OH), carboxylic group (COOH), quinone oxygen group (Ph=O) and alkoxy (R=O) groups. In acid electrolyte, the reactions involving these functional groups that may be responsible for conferring pseudocapacitance are given as [56];

$>CO + H^+ + e^- \leftrightarrow >COH$; $-COO^- + H^+ + e^- \leftrightarrow -COOH$;

$O = Ph = O + 2H^+ + 2e^- \leftrightarrow HO - Ph - OH$;

$R = O + H^+ + e^- \leftrightarrow R - OH$

Further Centeno et al., [57] describe three types of oxygen atoms namely, acidic, basic and inert, distributed evenly in the biomass-derived carbons, which may impart interesting electrochemical features by providing wettability, hydrophilicity etc. Further, H^+ in the acid electrolyte has the propensity to get adsorbed on the carbonyl moieties due to the ion-dipole attraction, given as;

$>CO + H^+ \leftrightarrow >COH^+_{(ads)}$; $>CO + H^+ + e^- \leftrightarrow >COH$.

Consequently, the charge density changes and gets added to the electrochemical double layer capacitance [58], enhancing the overall capacitance. It is reported that surface modification by oxidation is yet another attractive way of increasing surface oxygen to realize enhanced capacitive effects [23].

Next, nitrogen being an electron donor gives electrons to the delocalized carbon system that result in increased electrical conductivity. It is interesting to note that the nitrogen species can be divided into four different types: quaternary nitrogen (N-Q), pyridine-N-oxide (N-X), pyrrolic/pyridone nitrogen (N-5) and pyridinic nitrogen (N-6). Pseudocapacitance is expected via positively charged N-Q and N-X, which promote electron transfer through carbons and also by negatively charged N-5, N-6 [19, 59, 60,]. Out of these four, N-5 & N-6 nitrogens are important species contributing to pseudocapacitance. The mechanism of evolving pseudocapacitance due to N-containing functional groups on the carbon surface is depicted by the following electrochemical reactions [61];

$^{\wedge\wedge\wedge}C = NH + 2H^+ + 2e^- \leftrightarrow {}^{\wedge\wedge\wedge}CH - NH_2$;

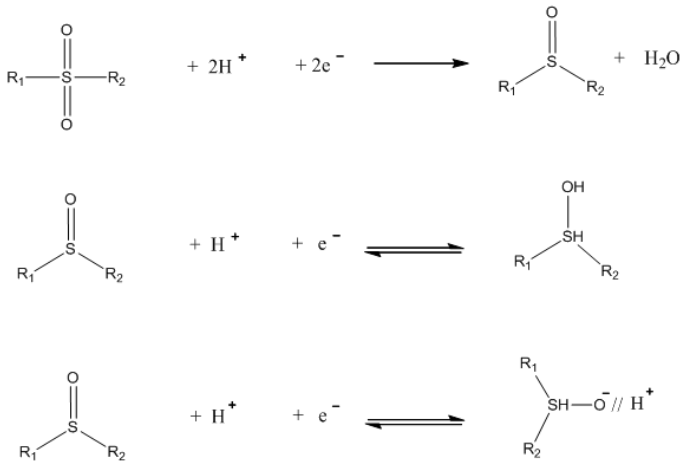
$^{\wedge\wedge\wedge}C - NHOH + 2H^+ + 2e^- \leftrightarrow {}^{\wedge\wedge\wedge}C{-}NH_2 + H_2O$;

where ^^^C stands for the carbon network of the ACs. The redox mechanism of nitrogen is believed to attract protons and improve the charge density of space charge layer.

Among the heteroelements, sulphur is the most active due to the presence of lone pair and easily polarizable electrons [23] and hence acts as a pseudocapacitance enhancer in supercapacitors electrodes. S-containing functional groups provide wettability to the electrode material resulting in reduced diffusion resistance between the electrode and the electrolyte ions thus leading to fast ion transportation in to the pores of the electrodes. In the presence of acid the sulphur species add to pseudocapacitance as per the reversible reactions [62] given below;

$O{=}S{=}O + 2e^- + H_2O \leftrightarrow {>}SO + 2OH^-$;
$>SO + e^- + H_2O \leftrightarrow >SOH + OH^-$

(or) some of the sulphone groups may be reduced into sulphoxide groups and the sulphoxide groups may then be reduced into sulphenic acid, which are also reversible, as shown below [62,63].



These reactions are also known to offer pseudofaradaic capacitance.

Yet another reason attributed for improved pseudocapacitance is that the N-groups improve electrical conductivity and at the same time sulphur widens the interlayer spacing of the carbon structure to provide abundant electrochemical active sites [19]. This could be a reason why sulphur in TLAC, though may be present to less than

1%, might have a significant contribution over nitrogen towards electroactivity and hence pseudocapacitance eventually. Nevertheless, the overall capacitance is the synergy between sulphur and nitrogen in the two GACs investigated.

It is reiterated in the literature that the electrochemical behavior of the carbon materials used as electrodes is related to their pore type/size, redox features due to the heteroatoms and also electrolyte medium. As describe above, the redox behavior of the GACs is explained by the presence of various hetero atoms containing organic groups on the GACs particles surface. In acid medium where H^+ is available in plenty, the heteroatoms present on the surface of the ACs interacts with the acid electrolyte to enhance the total capacitance through the pseudocapacitance effect bestowed from the Faradaic redox reactions presented individually for the three heteroatoms. In other terms, it can be stated that the remarkable capacitive currents and the total capacitance values in GACs is the combination of not only the electric double layer charging but also the pseudocapacitance arising from the electroactive functional moieties. Thus a clear picture of the Faradaic nature of the capacitor electrode fabricated using ACs containing heteroatoms in aqueous medium is demonstrated substantially by CV studies. CV recorded for GACs in acid electrolyte at 10-50mV/s, shows peaks around 0.3 to ~0.6V (Figure 7a) & 0.3 to 0.7V (Figure 7b) thereby exhibiting Faradaic charge transfer.

Table 5 gives the effect of scan rates on the specific capacitance, C_{sp} of GACs calculated from the respective CVs at the end of the 5^{th} cycle using the equation $C_{sp} = I/S$, (where S is the scan rate and I is the average current). As expected, the specific capacitance decreases with increasing scan rate. The reason for the decrease in capacitance at high scan rate is the reduced diffusion time and that the electrolyte ions cannot get full access to the pores or in other words, the ions might not diffuse easily and quickly in to the pores on the surfaces of the carbon at high scan rates. The result is the ineffective attachment of electrolyte ions at the electrode surface causing decrease in the capacitance. Because of the afore-said reasons, it can be contemplated that at high scan rates, the formation of the electrochemical double layer within the pores of the carbon particles is slower and less complete in comparison to the lower scan rates [31]. Thus only at low scan rates the ions transport/diffusion into the pores is facilitated to build up enormous charges and hence the capacitance. Yet another observation made from table 4 is that the rate of decrease in capacitance with scan rate is more pronounced for ASAC than TLAC for the obvious reasons mentioned above. Moreover, referring to the impedance data given in Table 4, R_{ct} is calculated to be lower for TLAC than ASAC in H_2SO_4 electrolyte and consequently, TLAC performance and the specific capacitance in acid electrolyte is higher than ASAC (but still in acceptable range). Similar trend in the results is also obtained from CV studies, proving that TLAC could be optimized further for designing a prototype of a capacitor.

Based on the above discussion, it can be stated that specific capacitance value exhibited by TLAC as well as ASAC electrodes in H_2SO_4 electrolyte appears very attractive to be considered for commercial applications. However, the enhanced capacitive behavior of TLAC over ASAC may be attributed, as mentioned earlier, to improved physical features like surface area, more mesopore volume and more, importantly the presence of sulphur-containing groups in TLAC acts as a pseudocapacitive performance enhancer, thus leading to a significant increase in the overall double layer capacitance.

To conclude CV studies, specific capacitance is a parameter dependent on the nature of the carbon electrode materials and the scan rate too. Carbonaceous materials with heteroatoms in surfacial organic functional groups tend to assist in the adsorption of the electrolytes backed-up by wettability, hydrophilicity or lipophilicity, electrical conductivity and electrolyte ion transport within the pores of the carbon materials would be the ultimate choice for electrode materials in capacitor devices [64]. It can thus be regarded that the sulphuric acid activated grasses carbon may be useful as an electrode material in capacitor applications.

Galvanostatic charge / discharge cycling studies (GCD) of GAC electrodes

GCD technique is extremely useful for evaluating long term cycling stability of the electrodes at a particular current density. The capacitive performance of GACs was demonstrated by comparing their charge/discharge multi-cycling responses in the potential window of -0.1-1.1V at 10mA/g current density for ASAC & TLAC in 1M H_2SO_4 as shown respectively in Figure 8 (a & b) where the first 10cycles are presented. An isosceles trianglular shape was exhibited in all charge–discharge curves which denote high efficiency electrodes with low internal resistance and potential drop [65]. Generally for an ideal electrochemical capacitor, the shape of the GCD curve is triangular, as the voltage changes linearly with time. But pseudoscapacitors show a non-ideal triangular shape due to various redox processes [66], as discussed under CV section. It is to be noted that the difference in charge and discharge time influences the symmetry of the isosceles triangle. Thus the contribution of pseudocapacitance can be discovered with the linear and curved portion in the GCD curves demonstrating the combination of pseudocapacitance and EDLC.

Moreover, cyclability of GACs has been assessed up to 500 cycles and table 6 lists the specific capacitance against cycle number for the two electrodes. The specific capacitance was calculated from the charge-discharge curves using the formula; $C = 2It/\Delta Vm$ where C is the single electrode specific capacitance of electrode material, I is the discharge current, t is the discharge time, ΔV is the voltage drop during discharge and m is the mass of electrode material in one electrode [67]. The specific capacitance calculated at the end of 500th cycle the specific capacitance is 356 F/g and 424 F/g respectively for ASAC and TLAC, the capacitance retention respectively being 88 & 92% of the initial capacitance. From table 6, it is inferred that TLAC electrode portrayed long-term cycle stability with high capacitance retention percentage.

As expected, electrode materials with higher BET surface area and larger mesopore volume show longer charging/discharging time, expressing their larger specific capacitance. Moreover, GCD profile for GACs exhibited the discharge time closer to that of the charge, reflecting high charge-discharge efficiency. The capacitance derived from GACs electrodes in acid electrolyte might have the contribution not only from double layer charging but also from the pseudocapacitance exhibited by surface functional groups. It is worthwhile to have the reports by [68] where the authors have hinted that the polarity due to the O-containing functional groups may hinder the ionic motion of electrolyte ions in the meso/ micropores and ionic motion in such small pores may be really slow that the available micropores on the electrode surface would not be utilized for charge storage at high currents, in this case 10mA/g [68]. This leads to an important conclusion that the N- & S-containing groups have a major role in determining the overall capacitance of the electrodes.

The above lines conclude that meso/micropores on the carbon surface, hydrophilicity or hydrophobicity, polarity, acidity, basicity or neutrality on the carbon surface due to the presence of hetero atoms containing organic moieties are important factors to be considered in developing a new and zero-cost carbon material for supercapacitors or pseudocapacitors. It is worth mentioning that after examining the research reports available on biomass-derived activated carbon samples, it is quite obvious that GACs gave a moderately high and respectable performance among many. Thus based on its favorable physical properties, the presence of inherent multi heteroatoms-containing organic functionalities and encouraging capacitive properties, grasses have successfully emerged as appropriate precursors for producing activated carbon samples that too without any catalysts and templates, thus making it inevitable as low-cost capacitor electrode. Nevertheless, developing an efficient mesoporous carbon material electrode should include significant consideration on high rate charge-discharge capability [69] and mainly, quantification of the heteroatoms of the biomass-derived carbons for a successful economically viable and green supercapacitor technology as our research should always be centered around circular bioeconomy and in that aspect, the authors of the present communication since quite recently has been focusing on the above concept for energy and few other applications.

CONCLUSIONS AND FUTURE PROSPECTS

To alleviate environmental pollution caused by discarded phytomass by dutifully utilizing them for producing sulphuric acid activated porous carbons for electrochemical application and further to establish circular bioeconomy in energy sector, the present work has been attempted and thus assumes highly relevant research theme in today's science of advanced materials. Two grasses were selected for the work to achieve the purpose of the work setting an example for circular bioeconomy. The carbon products inherently possess heteroatoms such as O, N &/or S in the carbon network creating a synergistic coupling effect between the heteroatoms thereby improving the physical properties of the activated carbons. The resulting capacitance is thus the coordinated effect of these surface heteroatoms and physical properties. Increased hydrophilicity because of O, low ESR with improved conductivity and surface wetting behavior of N and enhanced electrical reactivity and conductivity because of sulfur groups in TLAC sample are advantageous for the concomitant pseudocapacitive and EDLC adding to the overall supercapacitor performance. ASAC, where sulphur is absent, has a slightly lower capacitance based on the above reasons, but still in the acceptable frame.

Notwithstanding the present requirements and critical challenges, carbon materials with inherent heteroatoms could possibly display outstanding advantages like high rate capability, cyclability and chemical stability and thus represent promising candidates in the advancement of the supercapacitor technology, which the authors foresee to revolutionize the field of present day energy sector. Taking to the next level, the combination of GACs with materials such as graphene, MOFs etc will be promising for Li-ions, Li-S batteries, environmental remediation, electrocatalysis, CO_2 capture/storage, adsorbants etc. Circular bioeconomy is certain to minimize the environmental impact and maximize the resource recovery from biomass wastes. Thus the present work is an embodiment of the progress of an alternative supercapacitor electrode material from biowastes which aims at two main purposes: (1) to offer supercapacitor technology, through which an economic solution for sustainability of energy is provided. (2) to help with waste disposal management; converting waste to energy through circular bio-energy economy.

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Table 1. Elemental analysis of ASAC & TLAC.

Elements (%)	ASAC	TLAC
C	64.05	62.14
H	1.254	4.388
N	28.41	15.66
S	-	0.653
O	6.286	17.159

Table 2. FTIR signatures of ASAC & TLAC and their assignments.

ASAC		TLAC	
IR frequency (cm^{-1})	**Assignment**	**IR frequency (cm^{-1})**	**Assignment**
3784	free OH group	3788	free OH group
3474	-N-H stretching of amino group	3450	-N-H stretching of amino group
3148	-CH stretching of methyl group	3059	-CH stretching of methyl group
2926	-CH stretching of methylene group	2829	H-C=O stretching of aldehydes
2860	H-C=O stretching of aldehydes	2579	-S-H stretching of thiols
2409	OH stretching	2272	$-NH_2$ stretching of amides
2268	$-NH_2$ stretching of amides	1597	-NH stretching of amino group
1591	-NH stretching of amino group	1099	-S=O stretching of organic sulphoxides
1182	-C-O stretching of alcohol	783	-C-H bend
1089	C-O-C stretching of ether group	597	-S-H stretching of sulphide

Table 3. Porous properties of ASAC & TLAC.

Sample designation	S_{BET} (m^2/g)	V_{total} (cm^3/g)	V_{meso} (cm^3/g)	V_{micro} (cm^3/g)	average pore width; 4V/A (nm)
ASAC	901	1.01	0.49	0.52	4.48
TLAC	1113	1.41	0.94	0.47	5.06

Table 4. EIS data of GAC electrodes.

Sample designation	$R_s(\Omega)$	$R_{ct}(\Omega)$	C_{sp} (F/g)
ASAC	1.0	3.1	332
TLAC	1.3	0.4	394

Table 5. Effect of scan rates on the specific capacitance of GACs at 5th cycle.

Scan rate (mV/s)	Specific capacitance (F/g)	
	ASAC	TLAC
10	420	470
20	400	460
30	380	448
40	364	432
50	341	424

Table 6. Dependence of specific capacitance on cycle number.

Cycle No.	Sample designation	
	ASAC	TLAC
1	406	460
50	400	458
100	396	456
150	390	454
200	386	450
250	382	446
300	376	442
350	372	436
400	368	434
450	362	430
500	356	424
% efficiency after 500 cycles	88.0	92.0

Fig. 1. Image of *Aristida setacea* – AS (left) and *Thysanolaena latifolia* - TL (right).

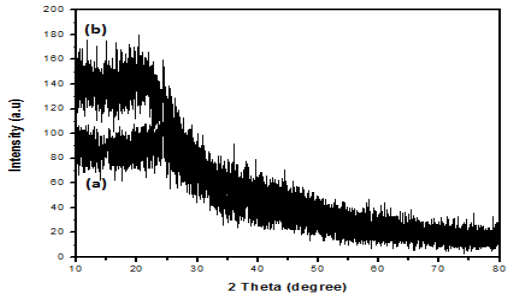

Figure 2. XRD of (a) ASAC and (b) TLAC

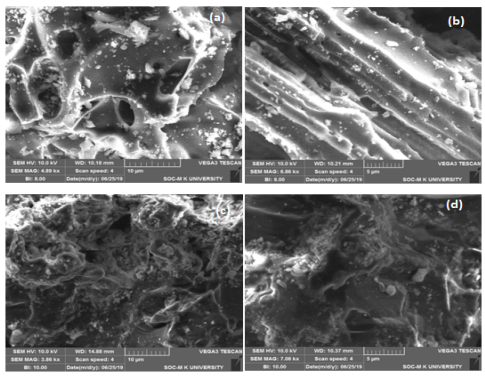

Figure 3. SEM of (a, b) ASAC and (c, d) TLAC.

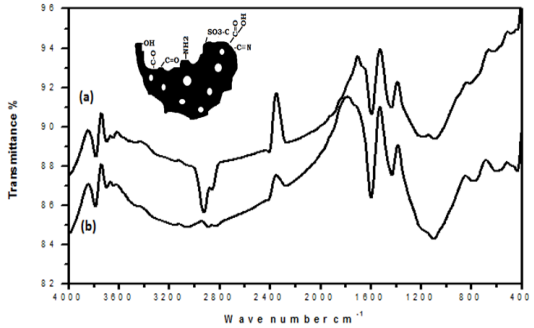

Figure 4. FTIR spectrum of (a) ASAC and (b) TLAC. Inset: Representation of various organic functional groups on the surface of AC. ♦ = carbon matrix; O = pores.

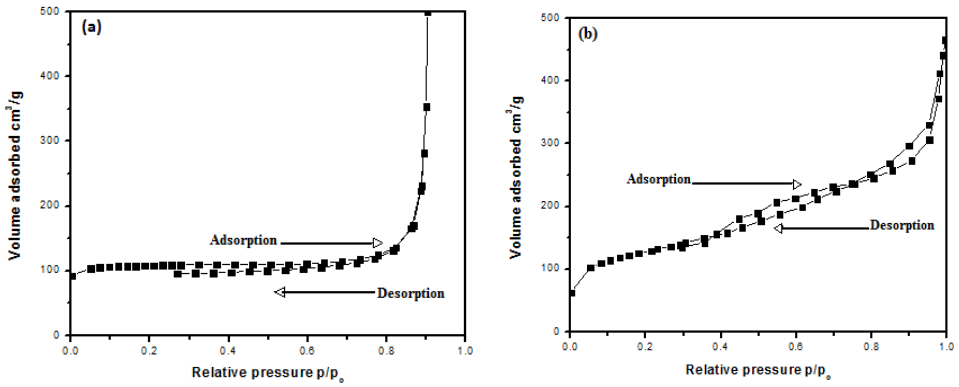

Figure 5. N_2 adsorption isotherms of (a) ASAC and (b) TLAC

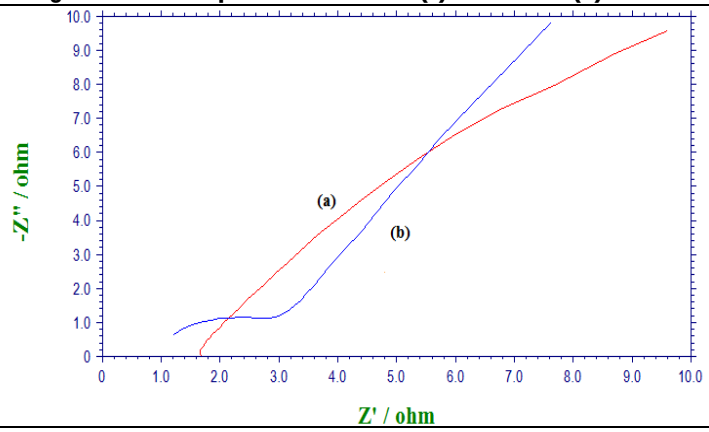

Figure 6. Nyquist plots of ASAC (a) & TLAC (b) electrodes

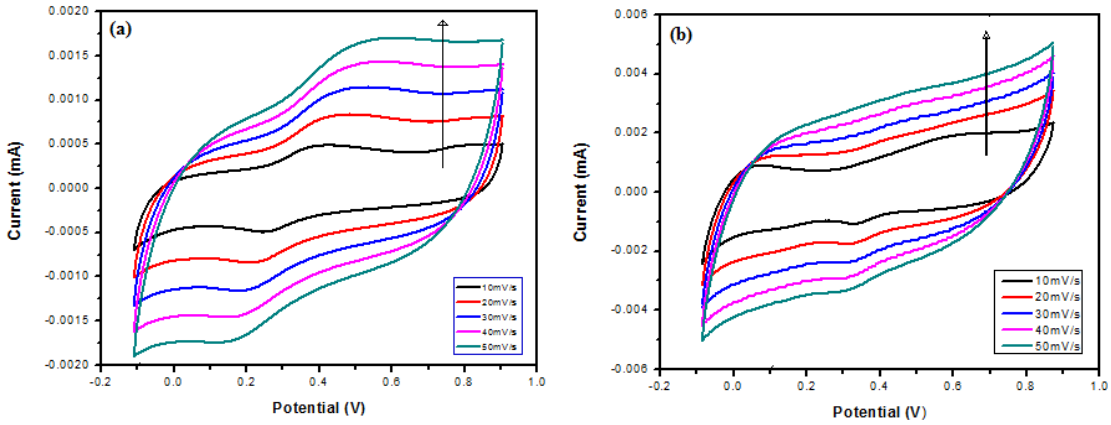

Figure 7. CV of (a) ASAC and (b) TLAC electrodes at different scan rates from 10-50mV/s in 1 M H_2SO_4

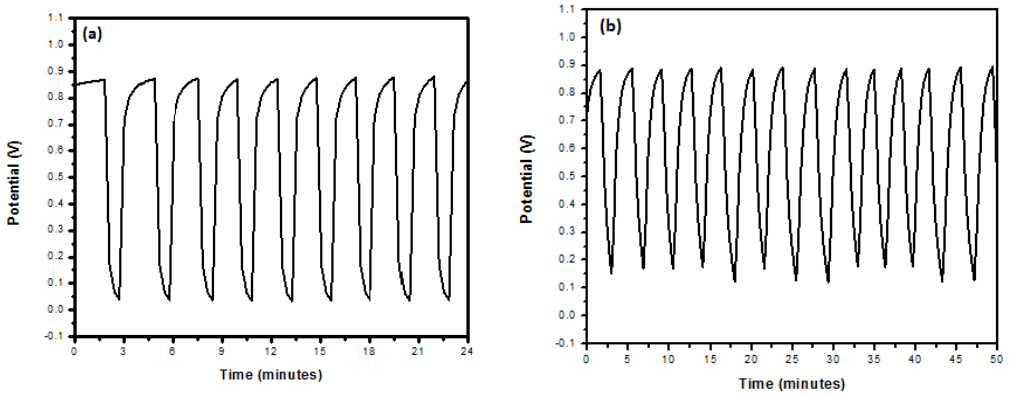

Figure 8. GCD profile of (a) ASAC and (b) TLAC recorded at 10mA/g in 1M H_2SO_4.

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REVIEW ARTICLE

Bioinformatic Tools to Understand the Defense Mechanism in the Tomato Plant

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ABSTRACT

Tomato as a plant is grown globally and India is one of its biggest producers. But overall production of the crop is hampered by various pathogenic diseases. A molecule known as systemin is produced for defense purpose in tomato. The systemin attaches with its receptor and produces several defensive proteins in downstream signaling pathway. But this defensive mechanism is very complex to understand. So, in order to simplify and understand the defense system of tomato various bioinformatics tools like docking, molecular simulations, etc. All the tools have helped in evaluating the role of systemin and found similarities with the animal defense mechanism also.

Keywords: Tomato, Systemin, Docking, SR160 receptor and molecular simulation.

INTRODUCTION

Tomato plant: defense mechanism

Tomatoes are a vital commodity for both fresh and refined food markets, with one of the most vocal agricultural yields in the globe. With an output of 19,007,000 tonnes, India is among top ten largest tomato producers in the world, with average yields that are higher than the global average [1]. In (Figure 1**)** global production of tomato indicated, that clearly represents top position of India in tomatoes production. Diseases are indeed a significant factor in tomatoes crop production and fruit numeric reduction. The *Alternaria solani*-caused early blight diseases are recurring in all producing areas, posing a threat to tomatoes production. This pathogen induces branch tumor in seeds, which is marked by dark-brown circular lesions that develop and form concentric circles in leaves and shoots, causing defoliation and, in extreme situations, exposing the fruits to sunburn; however, this pathogen triggers spots as well as decaying in tomatoes. Because of its effectiveness, induction of pathogenic resistance is one of the

alternative control measures that lead to activation of endogenous host defense in vegetables by biotic or abiotic stimulants. Proteins including catalase, phenylalanine ammonialyase, lipoxygenase, peroxidase, polyphenoloxidase, and β-1,3-glucanase are active pathways[2]. Several causes, particularly fungal, bacterial, and viral infections, cause tomato diseases. High temperatures and extended periods of rainfall favor numerous leaf diseases, including such late blight, and bacterial spots [3]. C.A Ryan proposed first sequence for Systemin, a phytohormone that binds to its receptor SR-160 and activates signal cascade for defensive genes activation. The FASTA format for Systemin of 18 amino acid accessed from NCBI-Genbank database and found to be as >prf1715381A systemin AVQSKPPSKRDPPKMQTD. Recent studies revealed its full structure, as data retrieved from NCBI-Genbank database for systemin and SR160 receptor of Tomato (*Solanum lycopersicum*). The sequence for systemin protein (201 amino acids) in FASTA format was retrieved with accession no. NP_001296103.1 [4], also Systemin Receptor 160 (SR160) sequence (1207 amino acids) in FASTA format was retrieved from NCBI-Genbank database with accession No. AAM48285.1 [5].

Systemin functions

In tomato, systemin is essential for defense signaling. It stimulates the development of more than 20 defense proteins, primarily anti-nutritional proteins, signaling cascade proteins and proteases. The over expression of pro-systemin resulted in a considerable reduction in larvae injury, suggesting that constitutive defense is superior to an inducible defense mechanism. Continuous activation of pro-systemin, on the other hand, is expensive, affecting tomato plant development, physiology, and reproductive performance. The development of protease inhibitors in tomato was severely hampered when systemin was silenced, and larvae feeding on the plants grew three times faster. Within three days of wounding, HypSys induced similar improvements in gene expression in tobacco foliar, with polyphenol oxidase functionality increasing 10 fold and protease inhibitors causing a 30% reduction for chymotrypsin activity. When HypSys was over expressed in tobacco, larvae fed on transgenic plants weighed half as much as the other that fed on normal plants after 10 days. As the formation of Systemin, HypSys,or At Pep1 is stimulated, the level of hydrogen peroxide in the vasculature tissues rises; this may be a factor in the initiation of systemic acquired resistance [6].

Tomato plants over expressing systemin accumulated HypSys as well, but not when the systemin founder molecule was silenced, suggesting that systemin regulates HypSys for tomatoes. Each of tomato's three HypSys peptides will stimulate the production and deposition of protease inhibitors. In comparison to wild type plants, when HypSys is silenced, the development of proteolytic inhibitors triggered via damaging is halved, suggesting that both systemin and HypSys are needed for a powerful defense response against herbivores in tomato. HypSys did not lead to the formation of protease inhibitors in *Petunia* when administered by cut petioles, but it did raise production of defensin, a gene that produces a protein that inserts into microbial membranes, creating a pore. At PEP1 also stimulates the development of defensin. Tomato plants that over expresses systemin contain more volatile organic compounds (VOCs) than standard plants, making them more appealing to parasitoid wasps. Systemin also controls the expression of genes that produce biologically active VOCs. Growing wasps will eat more floral substance till achieving full maturity, so such a response is critical if anti-nutritional defenses needed to gain. VOC production is possibly up regulated by a variety of mechanisms, along with the oxylipin pathway, which produces jasmonate aldehydes as well as ethanol aid repairing of wounds. *A. thaliana* may be able to differentiate amongst pathogens using various AtPeps. The changes in AtPep expression when inoculated with a fungal oomycete, or bacterium varied depending on pathogen type. The oomycete *Phythium* irregular was more immune to *A. thaliana* over expressing AtProPep1. Silencing systemin has little effect on black nightshade's ability to avoid herbivory, and in comparison to normal plants, subdued plants produced more elevated mass as well as fruit. For dark nightshade, systemin were down-regulated after herbivory, while the other polypeptide significantly upregulated. HypSys, and from the other extreme, was increased, allowing again for production for proteolytic inhibitor.

Systemin reduced expression found connected to root hair size but to not decreased shoot biomass, suggesting that systemin might produce formative activity in relation with herbivory, plants generally to endure without always

actively oppose assault. Tomato roots were likewise impacted by tomatoes systemin, with root development rising when the chemical was present in large amounts. Plants under attack are believed to store carbon by assigning more energy to their roots, which they utilize to regenerate until damage is over. In *A. thaliana*, over expression of AtPEP1 improved root and shoot biomass. It has been discovered that over expressing systemin and HypSys already been shown to affect crop's reactions towards salinity or ultraviolet exposure. AtPEP's are said to induce oomycetes resistance as well as to enable *A. thaliana* in pathogen differentiation. These results indicate that systemin either aided the plant's adaptation to salt stress or made them experience the situation as less stressful. Similarly, tomato plants that had been damaged were less prone to salt tension than those that had not been injured [7]. Alterations for traditional salinity stressed mechanisms do not account for the variations measured associated with genetically modified crops, according to a study of salt-induced gene expression changes. Many proposed that jasmonate mechanism activates a physiologic condition in which channels energy for development for pesticides, Crops too are pre-adapted to prevent loss of water. Such results were accomplished through suppressing the synthesis of hormones and metabolites, forcing plants to expand further energy to compensate for water depletion, which is a side effect of herbivores [8]. Plants grown in the presence of Ultra-Violet B light are more resistant to insect herbivory than plants grown in the absence of Ultra-Violet B light. Tomatoes crop irradiated with pulsating Ultra-Violet B radiation results to low injured, proteolytic inhibitor aggrandize in vine plant. Neither the radiation nor the poor injuring are necessary to cause systemic proteolytic inhibitor accumulation on their own. Systemin as well as Ultra-Violet B work in association with increased MAP-Kinases in tomato cell cultures in a related way. The alkalization of the culturing medium is often caused by short Ultra Violet B bursts [9].

Other similar proteins

Tobacco hydroxyproline-rich glycopeptides were isolated in 2001, and they enabled the synthesis of proteolytic inhibitor in the same way as tomatoe's systemin. Despite their structural dissimilarity to systemins, they were given the name hydroxyproline-rich systemins because of its similar feature (HypSys). Some HypSys peptides was discovered for pepper, petunia and black nightshade after the original observation. HypSys was discovered outside of the Solanaceae family for sweet potato (*Ipomoea batatas*) in 2007, and sequence analysis revealed HypSys analogues in poplar (*Populus trichocarpa*) and coffee (*Coffea arabica*) (*Coffea canephora*). Between species, systemins are strongly conserved. HypSys are much more diverse, however, most all seem to hold proline and hydroxyproline-rich core motif. In 2006, it was reported that AtPEP1, a 23-amino-acid protein derived of *Arabidopsis thaliana*, activates basic defensive-system responses mechanisms. AtPEP1 is not post-translationally modified by hydroxylation or glycosylation, unlike HypSys. There are six paralogs in *A. thaliana*, as well as orthologs in vine, rice, corn, wheat, barley, canola-soy bean medicago, as well as in poplar, though their presence has not been verified in assays. The cytosol of the cell contains systemin and AtPEP1. A 200-amino-acid polypeptide is transcribed as the precursor to tomato systemin. It lacking a suppositional indication chain, implying considering fact that it will be synthesized in the cytosol ribosomes. AtPEP1's precursor consist 92-aminoresidues without signal chain. In unwounded tomatoes leaves, this precursors of systemin was encoded by mRNA that is relatively little, but still it builds after injury, especially in epithelial cells major sieve components of the phloem in intercellular spaces of mid vein. The molecules aggregate largely in the phloem parenchyma cells from tomatoes following injury.

Systemin movement

As according numerous lines of biological studies, systemin seems to become an early component of wound induced signaling cascades which promote to defense genomic. First, GMO crops producing functional antisense pro-systemin cDNA exhibit a weak systemic wounded response but just a significant wound care reaction. Second, whenever a 35-S pro-systemin transgenic overexpresses pro-systemin, it causes constitutive activation of the wound response pathway. These observations, together with the observation that synthesized systemin applied to wound edge is transmitted systematically through to the phloem [10], have led to the fascinating hypothesis that systemin represents a lengthy signal for beneficial epigenetic modifications [11]. This theory states that systemin is translocated through the phloem to distal unharmed leaves after it is produced from prosystemin at the wounding site. The association of systemin with its potential receptor activates the octadecanoid receptor in target cells

pathway for JA biosynthesis, which causes the activation of protective genes. Systemin and wound-signaling pathways require jasmonic acid. Mitogen-activated protein kinases in tomato transmit the signal from the receptor (MAPKs). When 2 MAP Kinases, MP-Kinase1 and MP-Kinase2, were co-silenced in tomatoes, their protective reaction to wasp larvae was weakened in comparison to wild plants. Jasmonic acid synthesis as well as jasmonic acid dependent defensive genetic elements were also reduced when these genes were silenced. Plants that had been co-silenced were saved when they were given methyl jasmonate, showing that jasmonates are the stimulus that causes gene expression changes.

Bioinformatics: Molecular structural analysis

Computational bio-modeling is a branch of computer science that focuses on creating computer simulations of biological processes. To measure the complexity of biological processes, computational bio-modeling attempts to create and use visual simulations. Specialized algorithms and visualization tools are used for structure designing. After structure designing, ligand and receptors binding studies was conducted by deploying Molecular docking and Simulation analysis, which was found to be one of the fastest approaches even in drug designing and discovery [12]. Molecular docking tools of bioinformatics provide better interaction patterns with possible binding energies between two considered proteins.

Applications of Computational Bio-modeling

Computational bio-modeling is a branch of computer science that focuses on creating computer simulations of biological processes. Molecular docking and simulation analysis, which was found to be one of the fastest approaches even in drug designing and discovery [12]. Molecular docking tools of bioinformatics provide better interaction patterns with possible binding energies between two considered proteins.

Systemin defensive modulatory route in plants

Lipid-derived substances were involved throughout the constitutive activation that enables systemin to activate protecting processes. Systemin stimulate the production of linolenic acid (LA) through membranes, which is then transformed to phyto dienoicacid as well jasmonic acid, all are strong activators of protective genetics [18]. The pathway requires ethylene & jasmonates which trigger genes [19]. While pathogenic infection, that octadecanoid pathway [18] also facilitates the triggering of defense related genes through substrate signal transmitted by plant & fungus cellular membranes [20, 21]. Many crop underlying mechanisms in protection, strain, and growth prefer to be using the octadecanoid system as a signal transduction pathway [22]. Several studies have established the function of the octadecanoid mechanism in facilitating systemin activation. Most of the end genetic products (Figure 2) have defensive roles against insects and other microbial pathogens, as these products have significant control over expanding pathophysiology of infected plants.

Systemin: Botanical interactions and similarity to zoological physiology

The Systemin flagging pathway is affected by crops biochemicals, for example, abscisic acid (ABA) and indole acid. Plants inadequate in ABA do not produce proteinase inhibitors in light of injuring, as opposed to their wild type parent plants [23]. In a progression of reports [23, 24] ABA has been guessed to be a vital piece of the flagging pathway, and ABA-inadequate systems were accounted for to be unequipped for creating proteinase Inhibitor II mRNA because of systemin. Not withstanding, late proof [25] shows that ABA doesn't assume an immediate part in the flagging pathway however upgrades the systemin-initiated reaction that happens in foliar of both wild type and ABA lacking tomatoes, with the improvement being more articulated in the ABA deficients. Auxin has been accounted for to push down damaging reaction [26], however its impact on systemin-intervened acceptance of guard qualities has not been studied. The putative systemin receptor has not been recognized. Interesting investigations of radiolabeled system in with sanitized tomato leaf plasma films, no critical restricting of system into the films could be identified. A subsidiary of systemin, in which Serine 8 was supplanted with a biotinylated cystine and, was utilized to recognize systemin restricting proteins present in decontaminated tomato plasma layers [27].

Both the Cystine 8 replacement and the biotinylated subordinate were close to as dynamic as local systemin in instigating proteinase inhibitors in extracted tomato plants. When biotinylated systemin was blended in with refined tomato leaf plasma films and crosslinked, it specifically bound to a 50-kDa protein in the films. Nonetheless, the limiting protein looked like proteinases of the Kex 2p like prohormone convertases [28] as opposed to a receptor. When the biotinylated systemin was all the while named at Met15 with [35S] methionine, the biotin, in any case, not the radioactivity, was bound to the layer protein [27], demonstrating that at any rate four, and upwards of eight C-terminal deposits might have been divided from systemin during the cooperation with the protein. Inside the systemin amino acid arrangement is a dibasic cleavage site like that of a furin like catalyst [28], and an immune response against a Kex2plike protease from Drosophila repressed restricting of the biotinylated systemin to the film protein. Founders [27] propose that a systemin binding protein may be proteinase associated with a cleavage of systemin as a development step, working with systemin movement or its degradation. The expansion of systemin to *L. peruvianum* cell associated_organelles starts an alkalinization of medium joined by an expanded efflux of KC, an acceptance of 1-aminocyclopropane-1-carboxylatesynthase (ACC) and phenylalanine smelling salts exercises.

Such reactions were frequently seen in cellular organelles in numerous types crop-systems when tested with microbes or elicitors. Alanine 17 Systemin, the incredible opponent of systemin, was a powerless inducer of ACC synthase when added to the refined cells, however alienated the enlistment of the enzyme by systemin.Tomato (*L. esculentum*) cell societies do not show an oxidative burst when presented to either systemin or Ala-17-systemin, yet they potentiate the burst brought about by oligogalacturonides. The oxidative burst is a fast reaction of plant cells when uncovered to microorganisms or elicitors of safeguard reactions, contingent on the similarity in host-crop microbe collaboration [29, 30]. Oligo galacturonides are among the elicitors that reason the oxidative burst [31, 32].The flagging pathway intervened by systemin has been compared to incendiary reaction of macrophages and pole cells of animals in presence of microbes what's more, parasites [33, 34].

In the incendiary reaction, a cytokine, Tumor Necrosis Factor-α, initiates the arrival of Arachidonic acid (Twenty carbons and four two fold bonds) from animal cells, prompting prostaglandin amalgamation, fever, and the provocative reaction [35, 36]. Tomatoes foliar represent similar mechanism, where phytodienoicacid and JA, which are inferred from LA (eighteen carbons and three two-fold bonds) because of herbivore assaults, are analogs of animals prostaglandins [37]. Ca_2C, MAP kinases, and phospholipase A2 are significant in the arrival of arachidonic acid from animal cell [37], also the phosphorylation of phospholipase A2 via kinase proposed to prompt its actuation. Guide kinases have as of late been demonstrated to be actuated in plants by injuring [38, 39, 40, 41]. MAP kinase actuated by systemin [41] was appeared to work between the view of the essential sign [27]. An association of Ca^{2+}calmodulin in reaction of tomatoes to injuring what's more, similar to systemin type defensive activation in plants. So one can clearly indicate similar features between plant and animal defensive activation (Figure 3) in response to pathogenic impact over cellular physiology.

Sequence alignment approach: Protein based Evolutionary framework analysis

Multiple sequence alignment (MSA) is the mechanism or effect for aligning two or even more genomic/proteomic sequence, most commonly protein, genetic material, or nucleic acids. The source particularly uses array of sequence data is often thought to provide an evolutionary pattern during which each share a similarity and thus are descendants of a paternal lineage. The dynamic programming approach is used to find the globally optimum synchronization strategy in a direct process to processing an MSA. This process often uses two model parameters for proteins: a gap penalty as well as a substitute function that provides scoring and possibilities towards the arrangement of every potential pairing for amino acid residues depending upon that physic-chemical characteristics of amino acid residues. Hidden Markov systems (Figure 4) are stochastic algorithms that would allocate probabilities to every conceivable configuration between gaps, matches, and mismatches in terms of determining the much more plausible MSA as well as group of MSAs. HMMs may create a single largest performance or a collection of potential groupings that are then assessed on biological activity [42]. A genetic diversity model or evolutionary relationship providing phylogenetic cladistics can indeed be constructed using

several sequence alignments. This is probable mainly for two reasons. One is that quasi sequences can be aligned using biological functions that are identified in archived sequences. Another is that functional genetic conserved regions can indeed be identified [43]. Other solution towards solving MSA challenges is quantitative design, specifically mixed integer linear programming models. As opposed to the conventional DP method, certain optimization techniques do have privilege of being able to locate the correct MSA strategy relatively quickly. This one is partly due to the potential application of regression models for numerical programs, whereby the MSA framework is broken down into simpler and solved recursively first before best result is obtained. Branch and price and benders decomposition [44] are two examples of methods being used overcome MSA combinatorial optimization frameworks.

Phenetics utilized distance matrix-dependent approaches for build clusters based on the total resemblance in characteristics or related detectable features (i.e., in the phenotype or general similarity of Genetic material, not really the Nucleotide sequence), that was often thought to infer genetic tree. In (Figure 5), MSA and phylogenetic tree general depiction is provided evolutionary relation depends on the basis of sequence similarity score. In modern era phylogenetic trees were created using computational phylogenetics tools. Genome sequencing, cladistics, and computational biology all use similar methods. Neighbour-joining, maximal parsimony (also known as parsimony), UPGMA, Bayesian evolutionary inference, maximum probability, or different similarity strategies are all techniques for predicting phylogenetic trees [45].

Molecular Docking: principles and its application

Computational techniques in drug discovery and vaccine prediction basically revolve around molecular docking to retrieve perfect interaction models for ligand and receptor. Binding energies can be obtained for perfectly interacting complexes. Many tools like DINC, Patch Dock-Firedock, and Auto Dock-Vina are deployed to conduct molecular docking in various pipelines. Discovering drug and vaccine becomes easy due to use of advanced docking techniques. Also, allow researchers to screen out possible models of interaction on the basis of atomic contact energy, binding energy, and global energy. Docking is a systematic approach in which two molecules exhibits interaction due to the presence of functional groups. Lock and key binding was first described by Emil Fischer in 1894 [46]. Koshland described the further explanations for induced fit approach [47], which clearly indicates ligands have potential to induce conformational alterations in protein (Enzyme). Proteins in cellular environment orchestrated in too many conformations [48], described by an energy framework [49], and ligand entities selectively bind to lowest energy conformation [50, 51]. This explanation is termed as conformational selection; the ligand provides integrity and stabilization to one of the protein conformations [52]. The conformational selection is followed by an induced fit adjustment [53]. Molecular docking opens new dimensions in practical aspects rather than theoretical understanding, as deployed in drug designing [54] and epitope based vaccine prediction.

The common tools that were deployed in fast docking are particularly GOLD [55,56], DINC, PatchDock-Firedock, and AutoDock-Vina [57], most of the tools are free. DINC [58], PatchDock-Firedock [59] is free web servers where investigator can directly submit PDB files of receptor and ligand to obtain results. The best tool for performing docking is AutoDock Vina, which can be freely downloaded. Application of Molecular docking involve wide scope, like it can be used for interacting drug to protein, protein to protein, and mostly any ligand can be interacted to protein receptor. Molecular docking methods are applied for epitope based vaccine crafting and also for drug discovery approaches. Molecular docking can be conducted by various web servers, and parameters like atomic contact energy, global energy and binding scores are usually determined. Recently natural compounds were tested for pharmacoactive properties against SARS-Cov-2, on the basis of molecular docking and found to be effective [12]. Autodock vina was found to be best tool to obtain molecular docking results and to analyze interaction patterns between ligand and receptor molecules. Best docking results and affinity was generated by deploying autodock vina and MGL tools. It is the efficient method for docking ligands to receptors/proteins. In modern era, it opens many dimensions for fast computer aided drug designing and vaccine production.

CONCLUSION

This review helps in developing the understanding of the biological process that involves the interaction of systemin with its receptor. As systemin is the main component of the tomato's defense mechanism signaling. Therefore it becomes necessary to understand the basis behind the downstream process. Such type of studies will help laying the foundation stone of bioinformatics in the field of plant sciences and henceforth complex biological systems of the several other plants can also be studies.

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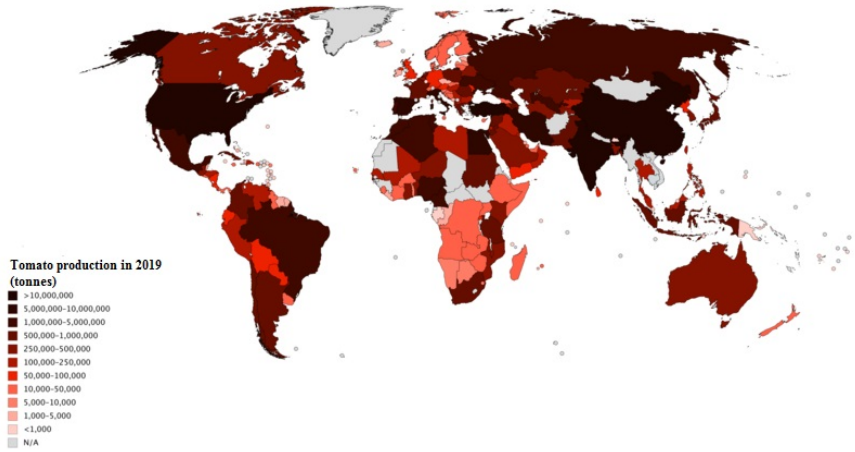

Figure1: Indian global position in tomatoes production with comparison to other countries.

Defensive Proteins	**Signal Pathway Components**
Inhibitor I	Systemin
Inhibitor II	Calmodulin
Cystatin	Lipoxygenase
Aspartic Protease Inhibitor	Allene Oxide Synthase
Polyphenol Oxidase	
Proteinases	**Others--Functions Unknown**
Leucine Aminopeptidase	Polygalacturonase Catalytic Subunit
Carboxypeptidase	Polygalacturonase β-Subunit
Aspartic Proteinase	Threonine Deaminase
Ubiquitin	Nucleotide Diphosphate Kinase
Ubiquitin-like Protein	Acyl CoA Binding Protein

Figure 2: End products after systemin dependent transduction accomplished in infected plants

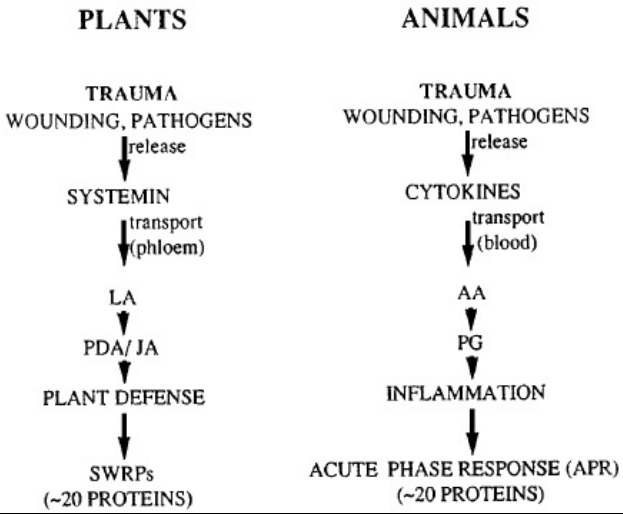

Figure 3: Similar features in Plant and animal defense mechanism

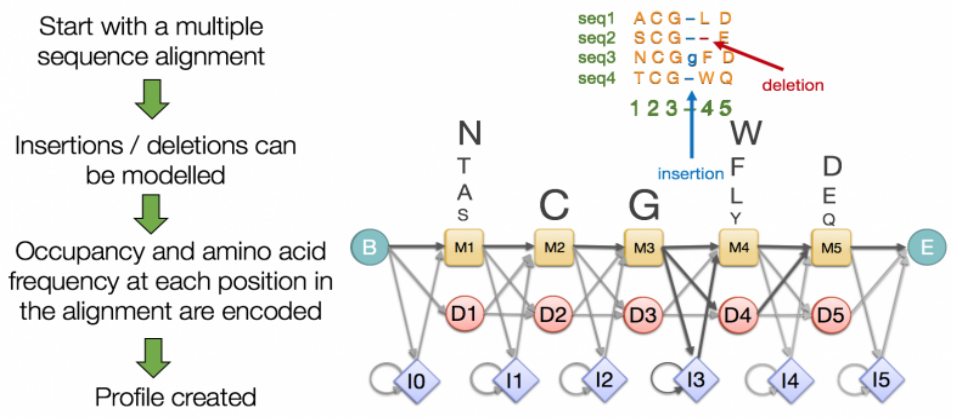

Figure 4: Hidden markov algorithm: statistical core algorithm used in cladistics.

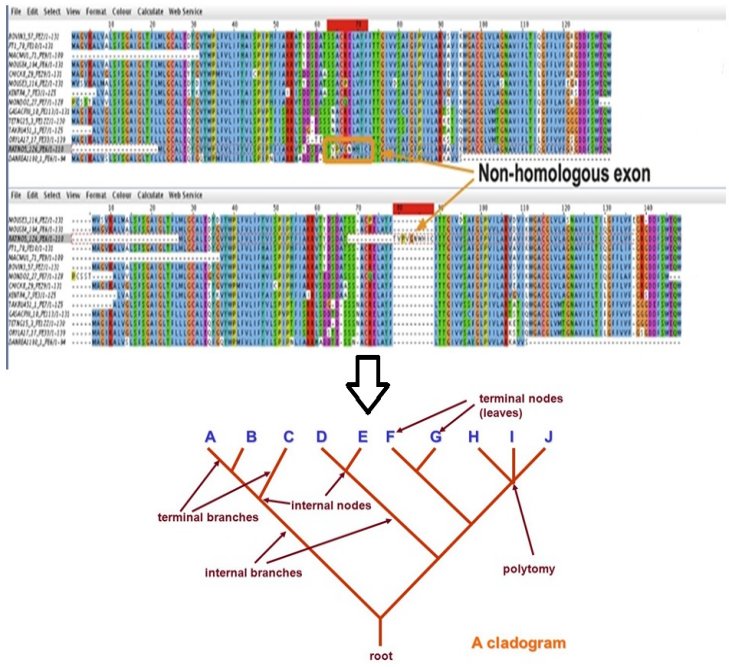

Figure 5: Multiple Sequence Alignment to cladogram construction

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REVIEW ARTICLE

A Narrative Review-Emerging Concepts in Glaucoma and Homoeopathic Management

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ABSTRACT

Glaucoma is a universal leading cause of irreversible vision loss. Mostly it is asymptomatic until the late stage and diagnosis is also frequently delayed. It is not a single disease process but a group of disorders characterized by a progressive optic neuropathy resulting in a characteristic appearance of the optic disc and a specific pattern of irreversible visual field defects that are associated frequently but not invariably with raised intraocular pressure Emerging evidence indicates that the pathogenesis of glaucoma depends on several interacting pathogenetic mechanisms, which include mechanical effects by an increased intraocular pressure, decreased neutrophine-supply, hypoxia, excitotoxicity, oxidative stress, and the involvement of autoimmune processes. Homeopathy is in fact oriented in this direction as far as visual disorders are concerned. The purpose of this article is to review the prior research on homeopathy and glaucoma.

Keywords: Glaucoma, Homoeopathy, Visual field and Optic nerve

INTRODUCTION

Glaucoma is a group of disorders with the common features of progressive degeneration of the optic nerve with thinning in the layer of retinal nerve fibres and increasing excavation of the optic disc. The biological basis of glaucoma is poorly understood and the factors contributing to its progression have not been fully characterized [1] Glaucoma affects more than 70 million people worldwide with approximately 10% being bilaterally blind, [2] making it the leading cause of irreversible blindness in the world. Glaucoma can remain asymptomatic until it is severe, resulting in a high likelihood that the number of affected individuals is much higher than the number known to have it [3,4]. Glaucoma's can be classified into 2 broad categories: open-angle glaucoma and angle-closure glaucoma. In the United States, more than 80% of cases are open-angle glaucoma; however, angle-closure glaucoma is responsible for a disproportionate number of patients with severe vision loss [5,6]. Both open-angle and angle-

closure glaucoma can be primary diseases. Secondary glaucoma can result from trauma, certain medications such as corticosteroids, inflammation, tumor, or conditions such as pigment dispersion or pseudo-exfoliation.

The many inherent difficulties always encountered in all the domesticated species in the attempted management of glaucoma to retain useful vision range from difficulty in diagnosis to the prevention of retinal ganglion cell death. Clinical experience alone dictates the expected poor prognosis for sight, but recent awareness of the mechanisms almost certainly involved the ganglionopathy clearly indicates that adequate neuroprotection might never be achieved. Not only are possible therapies still conjecture, but the early occurrence of what is probably a self-propagating process of neurodegeneration renders effective therapy particularly difficult in the species we treat. Currently our existing therapies must fall short of the mark and the practical difficulties associated with the assessment of outflow facility, the accurate monitoring of therapy and the complexity of surgical techniques all combine to confound the prognosis. Whilst it is logical that angle-closure-glaucomas can never be treated effectively by carbonic anhydrase inhibition alone, those glaucomas which do lend themselves to this kind of therapeutic approach are often diagnosed when ganglion cell death is already extensive and the loss of sight inevitable. The overriding factor in all glaucoma is the degeneration of the retinal ganglion cell, thus neuroprotection through effective ocular hypotension is the essential requirement of any therapy we utilise. However we are often too late in instituting that therapy and although we may contain associated pain and discomfort, the process of neuroretinal degeneration currently can neither be reversed nor stopped. The most we can achieve through the adequate reduction of intraocular pressure (IOP) is to slow this process down and retain sight for longer periods of time [7]. A marked partiality toward the field of alternative medicine has been observed within the blind community, on some occasions as a complement to traditional medicine and on others due to their openness to and acceptance of these branches of medicine, of which homeopathy is a clear example, which they consider to be less aggressive. Homeopathic medicine is based on the activation of the organism's healing mechanisms by administering homeopathic dilutions corresponding to specific doses of these medicines.

Pathophysiology of Glaucoma

The pathogenesis of glaucoma is not fully understood, the level of intraocular pressure is related to retinal ganglion cell death. The balance between secretion of aqueous humor by the ciliary body and its drainage through 2 independent pathways—the trabecular meshwork and uveoscleral outflow pathway—determines the intra-ocular pressure. In patients with open-angle glaucoma, there is increased resistance to aqueous outflow through the trabecular meshwork. In contrast, the access to the drainage pathways is obstructed typically by their is in patients with angle-closure glaucoma. Intraocular pressure can cause mechanical stress and strain on the posterior structures of the eye, notably the lamina cribrosa and adjacent tissues. The sclera is perforated at the lamina where the optic nerve fibers (retinal ganglion cell axons) exit the eye. The lamina is the weakest point in the wall of the pressurized eye. Intraocular pressure–induced stress and strain may result in compression, deformation, and remodeling of the lamina cribrosa with consequent mechanical axonal damage and disruption of axonal transport that interrupts retrograde delivery of essential trophic factors to retinal ganglion cells from their brainstem target [8,9]. Impaired microcirculation, altered immunity, excitotoxicity, and oxidative stress may also cause glaucoma. Primary neural pathological processes may cause secondary neurodegeneration of other retinal neurons and cells in the central visual pathway by altering their environment and increasing susceptibility to damage [10].

Management of Glaucoma

Glaucoma management is aimed at reducing IOP, the only known modifiable risk factor at this time. In some individuals, however, systemic factors such as uncontrolled systemic hypertension, vasospasm, sleep apnea, and arrhythmias may play a minor or major part in the development of glaucoma. The ultimate goal is to slow or stop structural and functional progression while maintaining or enhancing overall quality of life. Some recent evidence also suggests that visual field improvement may be achieved with IOP lowering [11]. The treating ophthalmologists should strive to maintain the IOP in a stable range to prevent further damage of the optic nerve [12]. The prostaglandin analogs are the preferred first agents for glaucoma therapy for a variety of reasons. These agents lower

IOP extremely well when dosed once a day and this effect has been shown to be long lasting without significant tachyphylaxis [13]. Achievement of targeted IOP might require aggressive treatment and frequent change of therapy; however, the target IOP range is a dynamic concept and it should be individualized and constantly re-evaluated, taking into consideration stage of disease, patient risk factors, life expectancy, and social circumstances. Furthermore, the means by which IOP targets are achieved can also be customized, and consideration of medications, laser, and surgical options may be required based on the patient's individual characteristics and circumstances.

Glaucoma and Homoeopathy

Homoeopathy a traditional system of medicine has many therapeutic methods for treatment of visual defects. Requirements for treatment was based on the following general concepts, patient's characteristics and constitutional data and his or her symptoms, and adapted for visual defect, Storage of complete pharmacopoeias on each medicine, Assignation of scaled dilutions of the remedies in the final treatment may be low (4 CH), intermediate (7 CH), and high (15 CH) dilutions. Assignation of the smallest possible number of necessary medicines. Few choices of remedies used in treatment of glaucoma.

Belladonna: Throbbing deep in eyes on lying down. Pupils dilated. Eyes feel swollen and protruding, staring, brilliant; conjunctiva red; dry, burn; photophobia; shooting in eyes. Exophthalmos. Ocular illusions; fiery appearance**.** Diplopia, squinting, spasms of lids. Sensation as if eyes were half closed. Eyelids swollen. Fundus congested.

Cedron: Shooting over left eye. Severe pain in eyeball, with radiating pains around eye, shooting into nose. Scalding lachrymation. Supra-orbital neuralgia periodic. Iritis, choroiditis.

Comocladia Dentata: Glaucoma, sense of fullness; eyeball feels too large. Motion of eyes aggravates. Ciliary neuralgia with eyes feeling large and protruded, especially right. Worse near warm stove; feels as if pressed outward. Sees only glimmer of light with left eye [14].

Phosphorus: Glaucoma. Thrombosis of retinal vessels and degenerative changes in retinal cells. Degenerative changes where soreness and curved lines are seen in old people. Retinal trouble with lights and hallucination of vision. Black points seem to float before the eyes. Patient sees better by shading eyes with hand. Fatigue of eyes and head even without much use of eyes.

Physostigma: Vision dim; from blur or film; objects mixed. Pain after using eyes; floating black spots, flashes of light, twitching of lids and muscles of eyes Nystagmus [15].

Osmium: Glaucoma; with iridescent vision. Violent supra and infra-orbital neuralgia; violent pains and lachrymation. Green colors surround candlelight. Conjunctivitis. Increase in intra-ocular tension, dim sight, photophobia.

Spigelia Anthelmia: Feel too large; pressive pain on turning them. Pupils dilated; photophobia; rheumatic ophthalmia. Severe pain in and around eyes, extending deep into socket. Ciliary neuralgia, a true neuritis.

CONCLUSION

There are several factors that predict glaucoma outcomes including stage of disease at the time of diagnosis as well as rate of progression. Homeopathyhas several remedies which can symptomatically treat glaucoma.

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RESEARCH ARTICLE

A Study to find out the Effect of Land Based Exercises on Improvement of Cardiorespiratory Functions among Chronic Obstructive Pulmonary Disease Subjects.

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ABSTRACT

The aim of the study is to find out the effect of land based exercises on improvement of cardio respiratory functions among chronic obstructive pulmonary disease. Participants were randomized into two groups. In experimental group patients received land based exercise and relaxation techniques. In control group patients received only relaxation techniques. Pre and post test evaluation is done using PEF. There is significant improvement in patients with COPD who received land based exercise and relaxation techniques when compared with the patients received relaxation alone. The present study proved that the land based exercise are effective in improving cardio respiratory functions among COPD.

Keywords: Chronic obstructive pulmonary disease, land based exercise, relaxation techniques, Peak flow meter, breathing exercise.

INTRODUCTION

COPD as "a disease state characterized by airflow limitation that is not fully reversible. The airflow limitation is usually both progressive and associated with an abnormal inflammatory response of the lungs to noxious particles or gases"[1]. In COPD, the lungs that is one of the major causes of morbidity and mortality worldwide [2]. Most patients with COPD are middle-aged or elderly. In 2000, 16 million office visits were attributed to COPD-related conditions [3]. COPD is a slowly progressing disease with a long asymptomatic phase, during which lung function

continues to decline. Persistent cough, particularly with mucus production, is a common symptom. Dyspnea, especially with exercise, wheezing, and chest tightness may also be present. Patients often present with the first acute exacerbation of COPD at an advanced stage. Symptoms do not usually occur until forced expiratory volume in 1 second (FEV1) is approximately 50% of the predicted normal value. As the disease progresses, exacerbations may become more frequent and life-threatening complications may develop. End-stage COPD is characterized by severe airflow limitation, severely limited performance, and systemic complications [4]. Cigarette smoking or exposure to noxious agents induces an inflammatory process in the lungs and airways of the bronchial tree that leads to small airway disease and parenchymal destruction [5,6]. COPD is characterized by a specific pattern of inflammation involving increased numbers of CD8+ (cytotoxic) Tc1 lymphocytes present only in smokers that develop the disease [7]. The inflamed airways of COPD patients contain also macrophages, T lymphocytes, and dendritic cells [8].

One of the most effective strategies for the management of chronic obstructive pulmonary disease (COPD) is land-based exercise training as part of integrated pulmonary rehabilitation. Land-based exercise training improves exercise capacity and quality of life [9]. Water-based exercise training had previously been thought to be unsafe for people with COPD due to the increased chest wall pressure and increased cardiac output that result from immersion in water [10]. The relaxation techniques help to breathe more effectively and efficiently. The progressive muscle relaxation is an effective treatment in people with chronic obstructive pulmonary disease. It is a therapy that focuses on tightening and relaxating the muscle. Breathing exercise (BE) has been an essential part of a comprehensive pulmonary rehabilitation program, for COPD patients. Many types of BE such as slow and deep breathing, active expiration, pursed-lip breathing (PLB), relaxation breathing, diaphragmatic breathing (DBE), and ventilatory feedback (VF) training, have been prescribed to decrease lung hyperventilation, enhance respiratory muscle function, exercise tolerance, and QoL in COPD patients[11]. The progressive muscle relaxation reduced anxiety and displeasure as well as reduces intensity of pain, and relieves stress in patient with chronic obstructive pulmonary disease [12]. So, the purpose of this study was to find out the effects of land -based exercise on improvement of cardio respiratory function among the COPD subjects. Hence we hypothesised that land-based exercise training in subjects with COPD would be more effective in improving cardio respiratory function.

METHODOLOGY

Patients who were referred to outpatient cardio pulmonary rehabilitation at an aarupadai Veedu medical college and hospital were included in this study, prior consent was obtained. Adequate measures were taken to avoid any bias. Subjects were excluded if they had unstable cardiac disease, contraindication to land based exercise. Adequate measures were taken to avoid any bias. Lung function was measured by Peak flow meter before the treatment values were recorded, then the subjects were taught with diaphragmatic breathing exercise, pursed lip breathing and segmental breathing exercise for a period of 10 days twice daily then the PEF values were measured and recorded . Each device was found accurate after being tested by the manufacturer in the laboratory, by using a calibrating device that could generate accurate flows between 0-900 L/minute, with a 30 milliseconds rise time and 10 milliseconds dwell time, with an abrupt fall of flow after reaching the PEF, the subjects performed at least three acceptable blows into the peak flow meter until the two highest PEF values were reproducible within 40 L/minute.

Inclusion criteria

- Moderate chronic obstructive pulmonary disease of age group 20 to 40 years
- Severe chronic obstructive pulmonary diseases of age group of 20 to 40 years

Exclusion criteria

- Unstable cardiac disease
- Long term oxygen therapy
- Inability to complete exercise training
- Body mass index > 35 kg

Participants who satisfying the eligibility criteria were randomized by an investigator. And then the participants were divided into two groups; Group A and Group B; Experimental and Control groups. Each group contains 15 participants. Group A received diaphragmatic breathing exercise, pursed lip breathing and segmental breathing exercise under supervision. And group B underwent relaxation techniques such as breathing exercises and progressive muscle relaxation techniques.

Data Analysis

The collected data were analyzed by paired't' test to find out the significant difference between pre and post –test values of experimental designs

RESULTS

Variables such as age, height, and gender, which are known to affect the lung function, were used to stratify the study population. Based on the age 35-39 (600), 40-44 (500).

Analysis of Dependent Variable Pain in Group A: The calculated paired't' value is 10.8 and the 't' table value is 3.250 at 0.005 level of significance(figure 1). Hence, the calculated't' value is greater than the table 't' value there is significant difference in PEF values following land based exercises among COPD patients. The statistical result shows that there is significant increase in PEF values and improvement of functional activity when using land based exercises.

DISCUSSION AND CONCLUSION

This is a randomized controlled trail in which the objective is to find out the effects of land -based exercise on improvement of cardio respiratory function among the COPD subjects. The purpose of this study is that there is a significant increase in PEF values and improvement of functional activity when using land based exercises. Based on the outcome of the statistical analysis, it is believed that the land based exercise shows significant improvement in subject with chronic obstructive pulmonary disease. It is definitely advantageous in reducing the symptoms in patients with chronic obstructive pulmonary disease. There is significant improvement in the respiratory parameter (PEF), functional improvement and improvement in the equality of life in chronic obstructive pulmonary disease patient.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest

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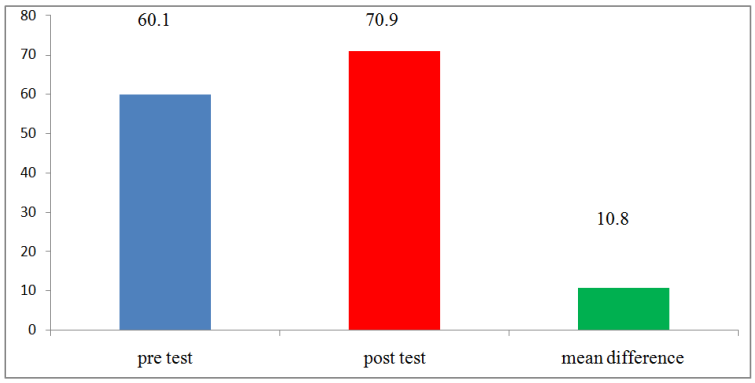

Figure: Shows the mean difference between the pre and post test for PEF

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RESEARCH ARTICLE

An Empirical Study on Challenges and Benefits in Working from Home: A Popular E-Business Model

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ABSTRACT

As a large variety of staff around the world beginning Work from Home in view of the COVID-19 pandemic, working from home is a general example and impacts associations in an unexpected way. Headway in information correspondence and web progresses moves the normal high level training and planning system absolutely into online e-guidance through overall schools. Understudies get chance to work and at the same time focus by choosing on the web in these overall schools. Right when web- based tutoring model is considered as next wave in high level training system, we tend to propose a plan of online workplace model as another framework to assist on- line instruction model. This paper contains the possibility of "Working from home "an online office back-up framework in affiliations and its inclinations to customers, laborers, and expert associations. Today there is an expansion in the quantity of associations that offer working from home alternatives, the quantity of monetary areas with occupations helpful for working distantly, and the level of laborers who accept that their work would be helpful for working from home. Remote workers are fundamentally gathered in callings that depend vigorously on phones, PCs, and other data innovation gadgets jobs generally helpful for working from home are those that: Are data based and versatile, Require a significant level offixation, Offer a serious level of self-rule, Can be arranged ahead of time and performed at different occasions, Involve insignificant guidance, assessment, and actual admittance to fix assets, Consist of making/controlling/spreading data

Keywords: Telework, satisfaction with telework, telework factors, telework outcomes, online office management, Challenges in work from home.

INTRODUCTION

This examination centered in on numerous conditions like Covid-19andinvestigated the cost saving implications for an in private closely-held business and their agents if they would be skilled and allowed to work from home. Further, associations among hidden and social elements with virtual work expertise were thought about. Considering the data assembled from 44 respondents, study found that prevailing piece of the agents were anxious to work from home and the hold assets to the association, are establishment, force, water, and constrained air frameworks, and consolidate structures, for instance, Telephones and therefore the internet, cleaning groups, and security. The reason for this paper is to research the connections between in theory grounded telecommuting factors and different individual and hierarchical results of telecommuting (by and large fulfillment with telecommuting, seen preferences of telecommuting, vocation openings and self-detailed efficiency). Albeit innovative advancements have made it feasible for representatives in numerous enterprises to telecommute, a few ventures will at present need to do it in the conventional method of going to their office and to their clients. Agam demonstrate that a harmony among work and home is fundamental to understanding the commonly useful connection among homegrown and proficient spaces of life. Consequently, various organizations will address telecommuting in an unexpected way, and will accomplish various results.

A portion of the Major Frequent Challenges are-:

- Working distantly/from home methods doing combating another arrangement of "interruptions" for example a kid needing consideration, a can in eyelping
- Lack of responsibility, as gatherings, workshops or labs are "just" virtual
- Technical issues may keep a few representatives from completing their work, signing in to a particular innovation or utilizing all highlights of virtual gatherings, workshops or labs apparatuses.
- Team individuals can't connect straightforwardly with their associates and pioneers and may feel detached, less imaginative or less beneficial
- Working distantly/from home regularly brings about a combination of labor and personal life and a couple representatives expertise problems to separate toward the finish of the work day.
- Other traps, like skilled segregation and hierarchical distinctive proof led to out and away off operative are often reduced by the creating of business focuses where individuals working distantly can go to cooperate mingle and share thoughts. This might involve interaction with people that add totally different fields, along these lines giving occasions to the trading of thoughts. Studies show that the impact on authoritative distinguishing proof would be more vulnerable for more established representatives who are in higher posts and acquire additional important compensations.

OBJECTIVES OF THE STUDY

In like manner, the particular targets of this examination were as per the following:
Objective 1: To evaluate the ability of representatives to telecommute.
Objective 2: To assess the monetary effect of telecommuting on the organization and its workers.
Objective 3: To examine connection among primary and social variables with experience with virtual work. Anyway in this examination, representatives is doing telecommuting, their work experience was tried. Further connection between proficient seclusion and occupation execution with virtual work was contemplated.

RESEARCH METHODOLOGY

Test and technique

In request to observationally assess the effect of telecommuting factors on business related results, an electronic review of 128 telecommuters (from the IT, protection, and telecom areas) was performed. The biggest IT, protection, and media transmission organizations that have telecommuting programs were reached and requested to partake in

the review. Heads of human asset branches of these organizations sent an encouragement to take an interest in the electronic study to their representatives. The mean period of respondents was 2.3 years, the normal authoritative residency was 1.2 years, Of the respondents, 59% were female; 66% of them were hitched/living together; 44.2% had no youngsters; 33% had one kid; 14.6% had two kids; and 7.4% had three kids (there were 0.97 kids per respondent all things considered). Telecommuting force among respondents was circulated as follows: full-time telecommuting – 21% and low maintenance telecommuting – 79%. Of the last respondents, 35.9% tele worked once or a few times each week; 20.7% – once or a few times each month; and 23.4% – once or a few times each Year.

Measures

The poll included ten telecommuting factors as free factors created for this examination (the quantity of things is shown in sections): 1) time-arranging abilities; (2) diminished time for correspondence with partners ; (3) plausibility to telecommute in the event of affliction; (4) director's trust; (5) administrator's help; (6) probability to lessen costs for movement; (7) probability to deal with relatives; (8) appropriateness of the working spot at home; (9) probability to get to association archives from home; and plausibility to work during the most beneficial time

Control factors

Previous exploration has indicated that telecommuting was more alluring to more established individuals as they had less desire for profession prospects However, more youthful individuals may likewise appreciate telecommuting as they esteem the opportunity to design their time and work independence

FINDINGS OF THE STUDY

The heap of hypothetically chose factors clarified a critical piece of the change of telecommuting results. Decreased correspondence with associates, director's trust and backing, appropriateness of the working spot at home were discovered to be the most significant telecommuting factors affecting diverse telecommuting results. Higher self-detailed profitability was identified with decreased time in speaking with associates, an appropriate working spot at home and the likelihood to deal with relatives when tele working. This examination gives experiences about the administration of telecommuting in associations by featuring the variables that advance the fulfillment, profitability and saw profession chances of telecommuters.

Working from home offers numerous favorable circumstances to associations that present and actualize this work plan with fitting preparing and thought of representative/chief fit. A working from home game plan can improve representative efficiency as people who work distantly are unaffected by commonplace office climate interruptions. This encourages a more noteworthy spotlight on work for more focused timeframes. Offering working from home work game plans additionally furnishes associations with a bigger ability pool from which to enlist and select. When working from home is offered as a choice, geological distances become less critical, or possibly unessential, in the thought of business. Besides, associations are better ready to utilize incapacitated, old, or others who are fit for business however whose actual conditions may keep them from chipping away at site. Another huge preferred position of working from home can be a decrease in the Organizations overhead/office costs. With expanding quantities of representatives telecommuting or in other distant areas, associations can frequently decrease their speculations and consumptions in places of business, parking areas, and other actual capital. Notwithstanding its preferences, working from home additionally presents difficulties for associations. The most clear for some is the apparent trouble in checking representative execution and estimating worker profitability. How does a chief understand what their worker is doing if the representative can't be seen? For associations and chiefs who regulate utilizing a view approach, working from home can be a disrupting work game plan that carries unwanted and ineffective change into the association. Along these lines, associations that actualize working from home plans should be focused on confiding in representatives, enabling people to decide, and estimating by results as opposed to acknowledgment. Another test introduced by working from home concerns creating cooperative energy and collaboration among remote workers and their collaborators. It is frequently hard to set up a shared trusting and

strong relationship among people who rarely collaborate with regard to. For purposes, for example, the advancement of working connections, a mix of working from home and on location work is favored throughout a full-time working from home work course of action. Our findings demonstrate that the appropriateness of the working spot at home reinforces all deliberate results of telecommuting (generally speaking fulfillment with telecommuting, seen preferences of telecommuting, profession openings, and expands self-detailed profitability). Accordingly, this examination bolsters the after effects of earlier exploration about the significance of the working spot for telecommuters' effectiveness and demonstrates that the foundation of a working spot at home ought to be perceived as a significant issue in the telecommuting game plan. The chance of getting to work records from home had no huge impact on telecommuting results. Given mechanical progression in associations, admittance to work reports might be considered as a cleanliness factor, yet not as an extra asset. Consequently, it doesn't increment great work results.

We found that more established specialists and ladies saw less favorable circumstances of telecommuting. Our discoveries on ladies' mentalities toward telecommuting challenge the prevalent public talk and the consequences of past investigations that ladies esteem telecommuting more than men do. This presumably exhibits changing sex ways of life in the current social climate, where men are progressively associated with the conveyance of family duties. Our discoveries on huge age-related contrasts in apparent telecommuting favorable circumstances are reliable with the after- effects of past examinations that more youthful representatives appreciate telecommuting, considering it as a wellspring of opportunity to design time and work self-governance. The negative impact of the number of kids on the general fulfillment with telecommuting is another intriguing finding of our investigation since it challenges the consequences of past exploration where telecommuting has been recognized as a critical chance for representatives with youngsters. We decipher this finding in the accompanying manner: an expanding number of youngsters can make it harder to oversee work–family issues at home; accordingly prompting diminishes in telecommuting fulfillment.

Another significant finding of our examination is that the likelihood to work when an individual is debilitated builds telecommuters' fulfillment with telecommuting. Consequently, our outcomes suggest that telecommuting might be an appropriate answer for associations to the test of presenteeism, which is identified with more efficiency misfortune than truancy. Hence, for representatives looking to satisfy their work commitments regardless of whether they are debilitated and who wish to make due in a competitive workplace, telecommuting makes this conceivable. At the individual level, the likelihood of telecommuting may lessen discouragement and related mental issues emphatically corresponding with presenteeism. This examination study analyzes the perspectives of advanced education understudies towards mandatory computerized and distance learning college courses in the midst of Coronavirus (COVID-19). Undergrad and postgraduate were reviewed to discover their viewpoints about online schooling in lacking zones. The discoveries of the examination featured that web based learning can't deliver want brings about immature area, where a larger part of understudies can't get to the web because of specialized just as financial issues. The absence of up close and personal association with the teacher, reaction time and nonattendance of customary study hall socialization was among some different issues featured by advanced education understudies

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Table 1. An employee's perspective

Advantages	Challenges
Self-sufficiency and adaptability over work routine	Trouble recognizing work and home time
End/Reduction of drive time	Sensation of separation structure work environment informal organization
Less cash spent on driving, stopping, work clothing	Insufficient gear or absence of specialized help
Higher assurance and occupation fulfillment	Ramifications of restricted connection w/supervisor for profession
Shirking of workplace issues	Sensations of antagonism/hatred from colleagues

Table 2. An Organization's perspective

Advantages	Challenges
Improved worker profitability	Trouble in worker execution observing
Lower worker truancy	Trouble in estimating worker profitability
Expanded representative maintenance	Change powers association outside safe place
Bigger ability pool from which to enroll/select	Conceivable negative consequences for work environment interpersonal organization
Decrease in overhead office costs	Trouble in encouraging group collaboration

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RESEARCH ARTICLE

The GC MS Study of One Ayurvedic Churnam, Avalgujabijadi Churnam

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ABSTRACT

The present study deals with the GC MS analysis of one Ayurvedic medicine, Avalgujabijadi chrunam, which is prescribed for skin diseases such as Vitiligo, Tinea infection and burns. The main constituent of this medicine is Avalgujabija, i.e. *Psoralea corylifolia* seeds, which is a proven medicine for skin diseases. Methods: The medicine, Avalgujabijadi churnam was procured from standard Ayurvedic vendor at Chennai and itsGC MS study was performed following proper protocol. Results: It was found that 26 chemical components such as Caryophyllene, Ficusin, Hexadecanoic acid, trans-Geranylgeraniol, Stigmasterol, .gamma.-Sitosterol, among others were identified which have some very important medicinal roles that correspond with the medicinal role of Avalgujabijadi churnam. Conclusion: Thus the genius of Ayurvedic proponents in choosing the right plant and right combination for treating a disease is proved abundantly. The roles of some of the molecules are however unknown and further work in this regard is warranted.

Keywords: Avalgujabijadichrunam, GC MS, Ayurvedic, Vitiligo, Tinea, *Psoralea corylifolia,* Caryophyllene

INTRODUCTION

The world is facing an entirely new medical phenomenon a due to the advent of Corona virus and mankind is struggling for survival. There is an urgent need of understanding the medical science in a totally new perspective. This is the right time for Alternative and Complementary medicinal forms such as Ayurveda, Sidhha, Unani, Chinese and other forms to come to the fore in facing this challenge. This is imperative to learn the mechanism of action of these alternative forms of medicine to use them more effectively. The present workers have made some initiative in this direction and the process warrants continuation to establish these alternative forms of medicine for the better health of mankind [1-23]. The present work is one step in this direction in which one Ayurvedic medicine Avalgujabijadi churnam was subjected to GC MS analysis to understand the molecules present therein and to probe their roles in support of the claims towards the roles of this medicine. Avalgujabijadi churnam is a medicine in powder form to treat vitiligo or leucoderma, tinea infection, dermatophytosis and also used for the treatment of burn injuries. The powder in mixed with cow urine and applied on the affected areas for 1 -2 hrs.and washed with warm water. This powder is prepared by mixing the powders of 187 g of Avalagujabeeja (seeds) – *Psoralea corylifolia* and 48 g of Sudhha Haratala (Purified Arsenic powder). The Ayurvedic reference for this medicine is Astangahridayam. The medicinal roles of *P. corylifolia* has been well documented by various research articles [24-26]. In Ayurveda and Sidhha forms of medicines the use of heavy metals such as gold, silver, mercury, arsenic and others is common and it is claimed that by rigorous processing the toxic effects of these heavy metals are reduced and they become effective medicines (Rao*et al,* 2014 a, b, c,d) [27-30]. The Purified Arsenic powder which is used as an ingredient in this medicine is also claimed to have such medicinal effects due to proper processing (Alappat*et al*, 2015) [31].

MATERIALS AND METHODS

Avalgujabijadi churnam was obtained from standard Ayurvedic vendor at Chennai and was subjected to GC MS analysis by standard procedure.

Instrument

Gas chromatography (Agilent: GC: (G3440A) 7890A. MS MS: 7000 Triple Quad GCMS,) was equipped with Mass spectrometry detector.

Sample Preparation

100 micro lit sample Dissolved in 1 ml of suitable solvents. The solution stirred vigorously using vortex stirrer for 10 seconds. The clear extract was determined using gas-chromatography for analysis.

GC-MS protocol

The GC MS Column consisted of DB5 MS (30mm×0.25mm ID ×0.25 μm , composed of 5% phenyl 95% methyl poly siloxane), Electron impact mode at 70 eV; Helium (99.999%) was used as carrier gas at a Constant flow of 1ml/min Injector temperature 280 °C; Auxilary Temperature : 290°C Ion-source temperature 280 °C. The oven Temperature was programmed from 50 °C (isothermal for 1.0 min), with an increase of 40°C/min, to 170°C C (isothermal for 4.0 min), then 10°C/min to 310°C (isothermal for 10min) fragments from 45 to 450 Da. Total GC running time is 32.02 min. The compounds are identified by GC-MS Library (NIST & WILEY).

RESULTS AND DISCUSSION

The GC MS profile of Avalgujabijadi churnam is represented in Figure 1. Table1 indicates the retentions time, types of possible compound, their molecular formulae, molecular mass and percentage peak area as shown in the GC MS profile of Avalgujabijadi churnam. The identification of metabolites was accomplished by comparison of retention

time and fragmentation pattern with mass spectra in the NIST spectral library stored in the computer software (version 1.10 beta, Shimadzu) of the GC-MS along with the possible pharmaceutical roles of each bio-molecule as per Dr. Duke's Phytochemical and ethnobotanical data base (National Agriculture Library, USA) and others as shown in Table 1 [32]. From Table 1 it is clear that the molecules present in Avalgujabijadi churnam, such as Caryophyllene, Ficusin, Hexadecanoic acid, methyl ester, n-Hexadecanoic acid, E,E,Z-1,3,12-Nonadecatriene-5,14-diol, trans-Geranylgeraniol, Stigmasterol, .gamma.-Sitosterol etc. are known for their anti-inflammatory, Catechol-O-methyl-Transferase Inhibitory, anticancer, anti-diabetic role etc. These roles could contribute in curing the skin diseases such as vitiligo, Tinea etc. Of late skin lotions, skin ointments etc. are containing heavy metals such as silver. The Ayurvedic proponents have used purified Arsenic in this medicine which could contribute to better treatment. Further work is warranted in regard.

CONCLUSION

From the above discussion it is clear that Avalgujabejadi chrunam is an effective medicine for skin ailments. Further work is warranted to understand the molecular mechanisms of the phyto-constituents as shown in the GC MS profile.

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Table1. Indicates the retentions values, types of possible compound, their molecular formulae, molecular mass, percentage peak area and their medicinal roles of each compound as shown in the GC MS profile of Avalgujabejadi Churnam

Sl. No	Retention Time	Compound Name	Mol. Formula	Mol. Wt.	% Peak Area	Possible medical Role
1	8.59	Caryophyllene	C15H24	204.2	0.80	Functions as non-steroidal anti-inflammatory drug
2	10.48	Caryophyllene oxide	C15H24O	220.2	0.83	It is a Nitric oxide synthatase inhibitor
3	11.34	Alloaromadendrene oxide-(1)	C15H24O	220.2	0.36	It is a Nitric oxide synthatase inhibitor
4	12.45	Ficusin	C11H6O3	186	10.01	Improves insulin sensitivity on adipose tissue, can be used for the treatment of obesity related type 2 diabetes mellitus.[33]
5	14.21	Hexadecanoic acid, methyl ester	C17H34O2	270.3	6.32	Catechol-O-methyl-Transferase Inhibitor, methyl Donar, Methyl Guanidine Inhibitor, Acidifier, Arachidonic acid inhibitor, Increases Aromatic Amino acid Decarboxylase activity
6	14.41	Phenol, 4-(3,7-dimethyl-3-ethenylocta-1,6-dienyl)-	C18H24O	256.2	2.77	Not known

7	14.60	n-Hexadecanoic acid	C16H32O2	256.2	0.58	Acidifier, Arachidonic acid inhibitor, Increase Aromatic Amino acid Decarboxylase activity, Inhibits Production of Tumor necrosis factor, Antidote, antitumor, Arylamine-N-Acetyltransferase Inhibitor, Decreases Norepinephrine Production, Gaba-nergic, Increases NK cell Activity, Myoneuro stimulant, NADH oxidase inhibitor
8	15.74	12,15-Octadecadienoic acid, methyl ester	C19H34O2	294.3	2.21	Catechol-O-methyl-Transferase Inhibitor, methyl Donar, Methyl Guanidine Inhibitor, Acidifier, Arachidonic acid inhibitor, Increases Aromatic Amino acid Decarboxylase activity
9	15.81	11-Octadecenoic acid, methyl ester	C19H36O2	296.3	6.32	Catechol-O-methyl-Transferase Inhibitor, methyl Donar, Methyl Guanidine Inhibitor, Acidifier, Arachidonic acid inhibitor, Increases Aromatic Amino acid Decarboxylase activity
10	15.93	Phenol, 4-(3,7-dimethyl-3-ethenylocta-1,6-dienyl)-		256.4	34.18	Not known
11	15.96	1,8:2,7-Dimethanodibenzo[a,e]cyclobuta[c]cyclooct en-13-one, 1,2,2a,7,8,12b-hexahydro-1-methoxy-	C21H18O2	302.1	14.82	Not known
12	16.08	Methyl stearate	C19H38O2	298.3	0.63	Catechol-O-methyl-Transferase Inhibitor, methyl Donar, Methyl Guanidine Inhibitor
13	16.61	Naphthalene, 6-(1,1-dimethylethyl)-1,2,3,4-tetrahydro-	C14H20	188.2	0.43	Not known

14	17.44	6-Octadecenoic acid, methyl ester, (Z)-	C19H36O2	296.3	0.38	Not known
15	17.47	15-Hydroxypentadecanoic acid	C15H30O3	258.2	2.07	Acidifier, Arachidonic acid inhibitor, Increases Aromatic Amino acid Decarboxylase activity
16	17.87	6S-2,3,8,8-Tetramethyltricyclo[5.2.2.0(1,6)]undec-2-ene	C15H24	204.2	1.15	Not known
17	18.83	Butyl 9,12-octadecadienoate	C22H40O2	336.3	2.10	Not known
18	18.88	Ethanol, 2-(9,12-octadecadienyloxy)-, (Z,Z)-	C20H38O2	310.3	1.60	Ethanol absorption inhibitor, increase Zinc bioavailability
19	20.45	E,E,Z-1,3,12-Nonadecatriene-5,14-diol	C19H34O2	294.3	2.06	Anticancer, Cytochrome P450-2E1-inhibitor, Decreases C-telopeptide excretion, decreases endothelial leukocyte adhesion, decreases endothelial platelet adhesion, decreases epinephrine production, decreases oxalate excretion
20	22.79	2-Naphthalenemethanol, 1,2,3,4,4a,5,6,8a-octahydro-.alpha.,.alpha.,4a,8-tetramethyl-, [2R-(2.alpha.,4a.alpha.,8a.beta.)]-	C15H26O	222.2	0.74	Not known
21	23.09	trans-Geranylgeraniol	C20H34O	290.3	0.55	Catechol-O-methyl-Transferase Inhibitor, Decreases glutamate oxaloacetate transaminase, decreases glutamate pyuruvate transaminase, glycosyle-transferase inhibitor, Increases glutathione-S-transferase activity (antioxidant), increasesglyoxalate transamination, Reverse transcriptase inhibitor
22	23.31	2,3,6-Trifluorobenzyl alcohol, benzyldimethylsilyl ether	C16H17F3OSi	310.1	4.67	Alcohol dehydrogenase inhibitor, detoxificant

23	23.57	3-(6-Bromo-benzo[1,3]dioxol-5-ylmethylene)-5-p-tolyl-3H-furan-2-one	C19H13BrO4	384	1.15	Not known
24	24.04	Stigmasterol	C29H48O	412.4	1.53	Precursor of progesterone, acts as intermediate in the biosynthesis of androgens and estrogens,it is anti-osteoarthritic, antihypercholesterolemic, cytotoxic, antitumor, hypoglycemic, antimutagenic, antioxidant, anti-inflammatory, analgesic[34]
25	24.38	.gamma.-Sitosterol	C29H50O	414.4	1.15	PPAR-gamma antagonist
26	26.20	Benzenepropanoic acid, 3,5-bis(1,1-dimethylethyl)-4-hydroxy-, octadecyl ester	C35H62O3	530.5	0.60	Acidifier, Arachidonic acid inhibitor, Increases Aromatic Amino acid Decarboxylase activity

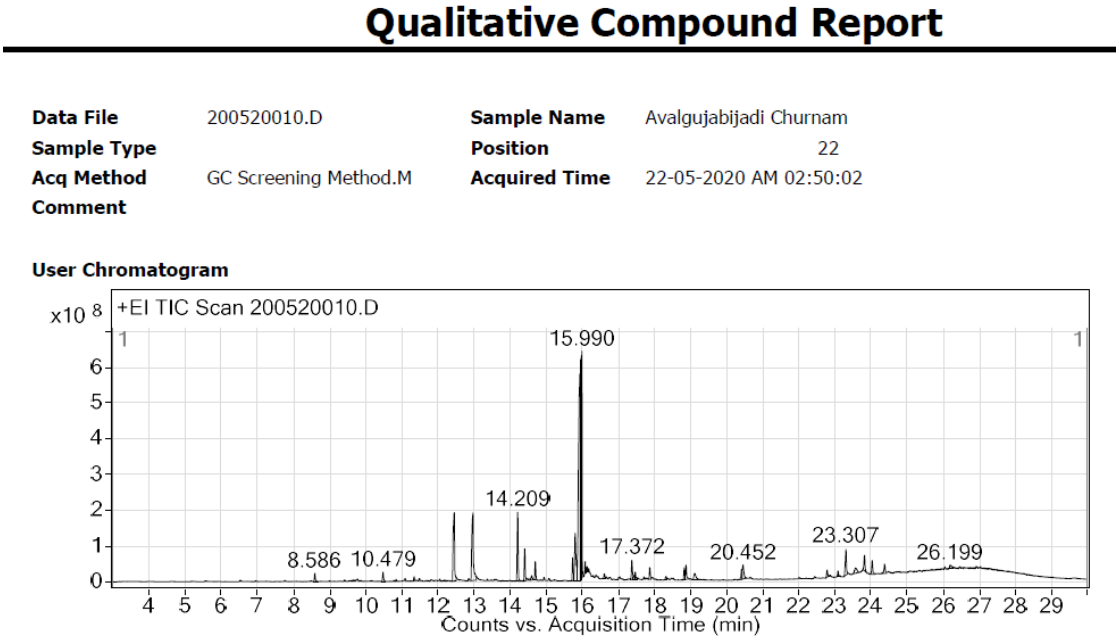

Figure 1.Indicated the GC MS profile of Avalgujabijadi churnam.

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RESEARCH ARTICLE

The Effect of Exercises on Primary Dysmenorrhea among Adolescent Girls in Rajasthan Sirohi District

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ABSTRACT

Primary dysmenorrhoea is defined as cramping pain in the lower abdomen that occurs just before or during menstruation with-out identifiable pelvic pathology. 2Primary dysmenorrhoea has been reported as the leading cause of recurrent absenteeism from school or work in adolescent girls and young women, and is considered to be a common disorder among women of reproductive age. The main objective of this research was to determine the effects of exercise on primary dysmenorrhea. A total of 672 adolescent female students with dysmenorrhea participated in the study. Recruitment was from September 2019 to FEBRUARY 2020. All samples that had regular menstruation and severe primary dysmenorrhea were divided randomly in two groups (intervention group: N= 352 and control group: N=320). The present study was designed to measure the changes in menstrual pain score before and after exercises and other therapies like warm compress and relaxation techniques. Total 672 subjects, were randomly divided into 2 groups: Group A: exercise group, Group B: Control group. 352 subjects were taken in group A and 320 subjects taken in group B. The results of group A and B were analysed by Wilcox on signed rank test. The comparison was made within the group. The results of this study show reduction of menstrual pain is significantly achieved in group. A compared to group B treated with exercises, relaxation techniques and warm compresses respectively. It is concluded that dysmenorrhea can be overcome by the exercises, relaxation techniques and warm compresses. Statistically exercises are more effective in decreasing the menstrual pain if compared with relaxation techniques and warm compresses.

Keywords: Adolescent girls, primary dysmenorrhea, sickness absenteeism, exercise.

INTRODUCTION

Menstruation is caused by the reduction of estrogen and progesterone at the best of the monthly ovarian cycle. During the 24 hours preceding the onset of menstruation, the tortuous blood vessels resulting in the mucosal layers of the endometrium become vasospastic. The vasospasm, the decrease in nutrients to the endometrium, and also the loss of hormonal stimulation initiate necrosis within the endometrium, especially of the blood vessels. As a result, blood initially seeps into the vascular layer of the endometrium and also the haemorrhagic areas grow rapidly over 24 to 36 hours. The necrotic outer layers of the endometrium become independent from the uterus at the sites of the haemorrhages and every one the superficial layers of the endometrium are desquamated. The mass of desquamated tissue and blood within the cavity and contractile effects of prostaglandins initiate uterine contractions that expel the uterine contents [1]. Dysmenorrhea (PD) is that the foremost typical gynaecological symptom reported by women of reproductive age.1It is defined because the recurrent, cramping pain, which occurs during menses, and lacks any identifiable system pathology.1,2Whilecramping pain could even be the sole real complaint, one or more of the subsequent symptoms may accompany the pain: nausea, breast tenderness, diarrhoea, fatigue, headache, dizziness, and more rarely, syncope and fever.1PD is usually treated by pharmacological agents that are often within the course of adverse side effects.3,4Accordingly, integrating alter-native nonpharmacological, non-invasive analgesia is preferred. Primary dysmenorrhoea is defined as cramping pain within the lower abdomen that happens just before or during menstruation without identifiable pelvic pathology [4]. Primary dysmenorrhoea has been reported because the leading explanation for recurrent absenteeism from school or add adolescent girls and young women and can be a typical disorder among women of reproductive age [6]. A survey of 1266 female university students found the overall prevalence of primary dysmenorrhoea to be 88%, with 45% of females having painful menstruation in each menstrual period and 43% of females having some painful menstrual periods [7]. In general, the handling of menstrual pain is split into two categories, namely pharmacologic and nonpharmacologic. Pharmacologically menstrual pain is often treated with analgesic drugs like ibuprofen and anti-inflammatory drug. Although analgesics can reduce pain effectively, the utilization of drugs can cause harmful and side effects. Additionally, to using pharmacological therapy, menstrual pain management can even be treated by nonpharmacological therapy [17]. Non-pharmacologic pain management is safer to use because it's no side effects. After all, it uses physiological processes. Pain management includes mild exercise or dysmenorrhea exercises, consuming fruits and vegetables, reducing levels of sugar and caffeine and massage techniques. Other non-pharmacological therapies are warm compresses, relaxation techniques like deep breath and yoga [18-20].

MATERIALS AND METHODS

A total of 672 adolescent female students with dysmenorrhea participated in the study. Recruitment was from September 2019 to February 2020. All samples that had regular menstruation and severe primary dysmenorrhea were divided randomly in two groups (intervention group: N= 352 and control group: N=320). The present study was designed to measure the changes in menstrual pain score before and after exercises and other therapies like warm compress and relaxation techniques. We recruited participants with only primary dysmenorrhea by using questionnaire to all the adolescent girls. Subjects included in this study were female students who experienced menstrual pain and fulfilled the inclusion requirements. The sampling method is purposive sampling, which is based on a certain consideration in accordance with the inclusion criteria.

Inclusion criteria

- Adolescent girls age group between 13-16 years, who attained menarche.
- Adolescent females with premenstrual symptoms
- Pelvic pain

- Females who are willing to participate with their parents' permission
- Adolescent females who had regular cycle between 21 to 40 days for the past three cycles
- Females with BMI ≥ 18.5
- Oligo / amenorrhea

Exclusion criteria

- Adolescent Females who are under treatment for any uterine problem
- Those who are physically challenged
- Those who are taking any pain killer or spasmodic drug regularly for any other problem
- Those who are having any other gynaecological problem
- Those who underwent any minor or major surgery within 3months
- Those who were absent on the day of data collection.

The aims and objectives of the study were explicitly explained to the participants before the commencement of the study. All participants voluntarily gave written informed consent to participate in the study. A quasi-experiment design with a pre and post-test control group design approach was used. The volunteer participants were divided into two groups randomly: intervention and control groups. A pre-test was carried out in the intervention and control groups by showing the scale of menstrual pain. Exercises was applied only to intervention group and in control group warm compress and relaxation exercises was applied. Then the post test was applied to both the groups.

The subjective data were collected by using a questionnaire. In the present study a visual analogue scale measured the severity of pain, MOOS Menstrual Distress Questionnaire (MDQ) for measuring the severity of various menstrual symptoms and Verbal multidimensional scoring system (VMSS) for assessment of dysmenorrhoea severity. This technique involves the use of a 10 cm line on a sheet of paper and represents the continuum of the girl's opinion of the degree of pain. It was explained the one extremity of the line represented unbearable pain and the other extremity, no pain at all the girls rated the degree of pain by making a mark on distance from zero to that mark (15). After observation on 2 cycles, exercise group were educated the subsequent exercises.

1. **Cat stretches:** Arch your back; by tucking chin in. Hold for 10 seconds then relax. Round back, pushing it toward the ceiling by dropping your head toward the ground. Hold for 10 seconds, counting aloud. Maintain a rounded back. Sit back on heels, stretching your arms move ahead of you as far as possible. Hold for 20 seconds, and later relax.
2. **Lower trunk rotation:** Lying on back, knees bent, feet on the ground, arms extended out. Keeping the arms straightened horizontally, place shoulders on the ground the maximum amount as possible. Bend both knees and roll them towards left. Hold for 20 seconds, then roll to the proper side.
3. **Hip stretches:** Lying on back, knees bent. Bend one leg with knee flexed, and take a look at to drag it towards chest. Maintain the alternative leg extended on the ground or bed. Hold for 20 seconds, then return to the starting position and relax. Repeat on the alternative side.
4. **Abdominal strengthening:** Lying on back on the ground, knees bent, feet on the ground, hands resting beneath head. Clasping hands behind head, flex upper body in towards the knees. Hold for 20 seconds, counting aloud and later relax.
5. **Lower abdominal strengthening:** Lying back on the bottom, knees bent, arms extended out. Hold an exercise ball between heels and buttock. Flatten the lower back against the ground by tightening the muscles of abdomen and buttock. With the ball held between the legs against thighs, bring both knees up toward the chest. Slowly lower both legs to starting position.
6. **Bridge position:** Lying on back on the ground, knees bent, feet and elbows on the ground, arms extended out. Flatten the low back against the ground by tightening the muscles of abdomen and buttock. Lift up hips and lower back. Hold for 20 seconds, then return slowly to starting position and then relax

7. They should do these physical activities once in a day for 30 min and stop doing all the physical activities during the menstruation. With telephone or refer to the high schools, we were confident that they do these physical activities. All two groups recorded the character of menstruation in cycle 3 and 4. After 2 cycles with physical activity in exercise group and observation in control group, data were analysed with SPSS.

STATISTICAL ANALYSIS

The data were analysed using the Statistical Package for Social Sciences 16.0 (SPSS). Non parametric tests were used for analysis.

RESULTS

Total 672 subjects, were randomly divided into 2 groups: Group A: exercise group, Group B: Control group. 352 subjects were taken in group A and 320 subjects taken in group B. The results of group A and B were analysed by Wilcox on signed rank test. The comparison was made within the group. The pre-test and post-test mean values of VAS scale for group A is 7.9062 and 4.6392 and group B is2.4125 and 5.8250. This shows that there is significant improvement in pain reduction in group A ($p<0.0001$). in group B there is no significant improvement in pain. The pre-test and post-test mean values of MOOS Menstrual Distress questionnaire for group A is 5.2188 and 3.0085 and group B is 5.2750 and 3.9031. This shows that there is significant improvement in reducing severity of various menstrual symptoms in both the groups ($p<0.0001$). The pre-test and post-test mean values of VMSS for group A is 0.46968 and 0.54110 and group B is 2.4125 and 1.4094. This shows that there is significant improvement in reducing severity of dysmenorrhea in both the groups($p<0.0001$).The results of this study show reduction of menstrual pain is significantly achieved in group A compared to group B treated with exercises, relaxation techniques and warm compresses respectively.

DISCUSSION

This study was aimed to find out the effect of exercise on primary dysmenorrhea. In current study pain had reduced in primary dysmenorrhea more in exercise group than in control group. The findings are similar to those of various previous studies (17 – 23). Even though a number of studies have failed to find any relation between primary dysmenorrhea and physical activity. For almost half a century, exercise has been thought that relief or even cures primary dysmenorrhea and in the last 15 to 20 years, researches for the link between physical activity b and menstrual disorders have increased significantly. Decline in the severity of symptoms after 12-week aerobic training program was shown (14). Another report showed diminished dysmenorrhea in junior high school girls (7). Similarly, women who train regularly have been found to report fewer symptoms than women who exercise occasionally (16).

Golub et al (13) studied the effectiveness of the exercise on the frequency of premenstrual difficulties and dysmenorrhea among high school girls over a 3-year period, at the end of which,39% of the exercise group suffered from dysmenorrhea compared with 61% of the control group ($P<0.05$).The investigators, however, did not differentiate between primary and secondary dysmenorrhea. Prior to enrolment, the subjects were also informed that special exercise was effective in preventing and relieving menstrual discomfort and it was important to perform that exercise daily. Izzo and Labriola showed that dysmenorrhea was less prevalent in athletes who had begun their sports activities prior to menarche, and that there was improvement in symptoms after initiation of exercise, and athletes participating in more intense sports activities had less severe menstrual symptoms (16).Pain is extremely subjective symptom and it has been very difficult to quantify pain (25). Researchers have, therefore, found out a way to measure pain by various scoring systems like VAS (26). Depending on pain score obtained on VAS, pain was divided into mild, moderate and severe pain and thus it is called 3-point scale. In our study, it was revealed that 18%, 40% and 42% of students had mild, moderate and severe pain (dysmenorrhoea) respectively.

CONCLUSION

From this study, it is concluded that dysmenorrhea can be overcome by the exercises, relaxation techniques and warm compresses. The advantages of this methods are safe, easy, free of charge, free of side effects and it can be done alone. Statistically exercises are more effective in decreasing the menstrual pain if compared with relaxation techniques and warm compresses.

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Table 1: Pre-Test an D Post-Test Values of Group A

	N	Mean	Std. deviation	Minimum	maximum
VAS – Group A pre	352	7.9062	.86710	6.00	10.00
VAS – Group A post	352	4.6392	.69426	3.00	6.00

Table 2: Pre and Post Test Values of Group B

	N	Mean	Std. deviation	Minimum	maximum
VAS – Group B pre	320	2.4125	.49306	2.00	3.00
VAS – Group B post	320	5.8250	.94055	4.00	7.00

Table 3: Pre-Test an D Post-Test Values of Group A

	N	Mean	Std. deviation	Minimum	maximum
MOOS– Group A pre	352	5.2188	.69215	4.00	6.00
MOOS– Group A post	352	3.0085	.82858	2.00	4.00

Table 4: Pre and Post Test Values of Group B

	N	Mean	Std. deviation	Minimum	maximum
MOOS– Group B pre	320	5.2750	.64764	4.00	6.00
MOOS– Group B post	320	3.9031	.77983	3.00	5.00

Table 5: Pre and Post Test Values of Group A

	N	Mean	Std. deviation	Minimum	maximum
VMSS– Group A pre	352	2.3267	.46968	2.00	3.00
VMSS– Group A post	352	.6619	.54110	.00	2.00

Table 6: Pre and Post Test Values of Group B

	N	Mean	Std. deviation	Minimum	maximum
VMSS– Group B pre	320	2.4125	.49306	2.00	3.00
VMSS– Group B post	320	1.4094	.55813	.00	2.00

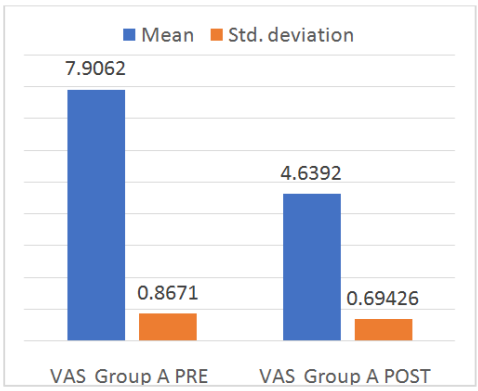

Figure 1: Comparison of pre- test and posttest values of VAS for Group A

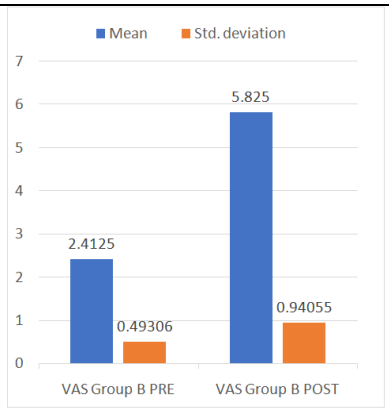

Figure 2: Comparison of pre- test and post-test values of VAS for Group B

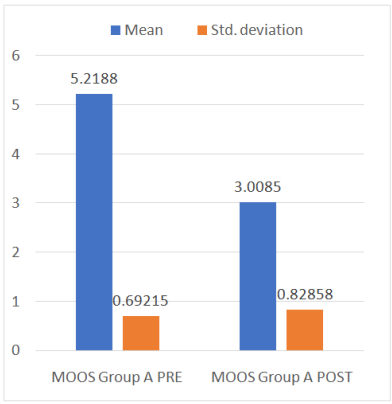

Figure 3: Comparison of pre- test and post-test values of MOOS for Group A

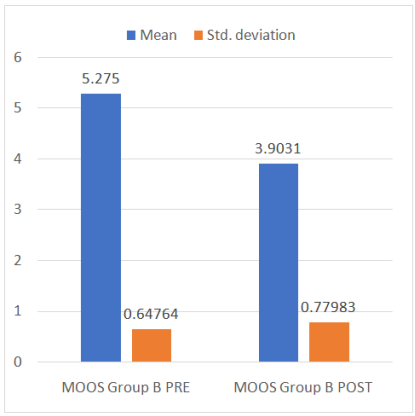

Figure 4: Comparison of pre- test and post-test values of MOOS for Group B

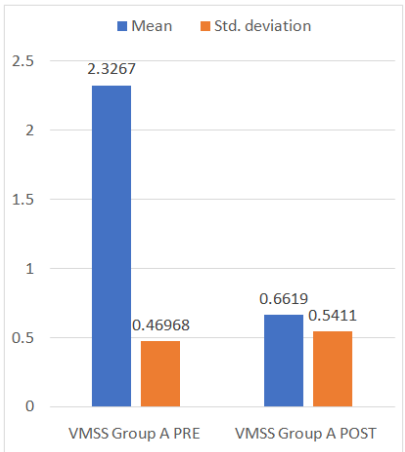

Figure 5: Comparison of pre- test and post-test values of VMSS for Group A

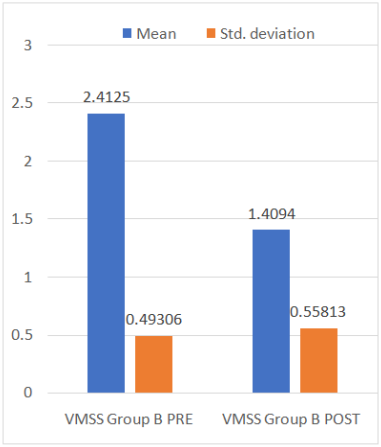

Figure 6: Comparison of pre- test and post-test values of VMSS for Group A

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RESEARCH ARTICLE

Patient Parameter - Based Portable Hyperbaric Oxygen Therapy for an Emergency

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ABSTRACT

A portable hyperbaric chamber can be designed for emergency treatment, which can be administered to the patient at the site of accident or mishap, without much delay, thereby increasing the chances of survival of the patient. As the aim is to build a device for emergency, the bulky oxygen cylinder for delivering complete oxygen to the patient inside the chamber, is excluded retaining the hyperbaric environment inside. Understanding the patient health parameters influencing the patient, before undergoing the therapy and providing a safe pathway for HBOT by means of a system to monitor the parameters to make sure whether the treatment is applicable for the patient's condition or not, defines the scope of this project. The electrocardiogram, heart rate, respiration and temperature of the patient is acquired, and the patient history is stored in a patient card which is read by a suitable card reader.

Keywords: Hyperbaric Oxygen Therapy, Sensors, Patient Monitor, IOT Technology, Emergency Treatment, Vital Parameter

INTRODUCTION

Hyperbaric Oxygen Therapy (HBOT) is a medical treatment which enhances the body's natural healing process by inhalation of 100% oxygen in a total body chamber, with an internal pressure, higher than the normal. Stationary

(rigid) Chamber is used to deliver the treatment in Hospitals & Defence Training. Portable Chamber can be kept in public places & used for the proposed Emergency situations.

Need for a portable means of treatment

Some of the health problems faced by people in public places can be solved by means of a suitable treatment modality. During an emergency, situation, if the treatment is administered to the patient at the site of accident or mishap and without much delay, the chances of survival of the patient is more. The treatment can help sustain the patient until hospitalization. Such a treatment can be delivered using a portable hyperbaric chamber. The following are some of the problems that can be addressed by the chamber. 1. Asphyxiation leading to suffocation or shortness of breath can occur in crowded places like airports, railway stations and places of worship 2. Burn injuries and carbon monoxide poisoning during fire accidents, especially in construction or mining sites, factories and industries. 3. Air gas embolism and decompression sickness in adventure sports like scuba diving. 4. Injuries suffered by athletes during sports training and the need to sustain their energies for long periods of time on the field. 5. Choking due hanging or drowning. The portable device also provides a non-invasive form of treatment, with minimal side effects. Pressure depends on treatment guidelines and indications. It is one of the safest therapies among the other therapies found today. Considerably to the last decade, the understanding of the HBOT mechanism for the clinical benefits has been increased. The critical issues in HBOT involve the failure of the monitoring of the patient's health parameter. It is important to understand the health influencing parameters of the patient before undergoing hyperbaric therapy. The utmost intention this research is to provide a safe pathway for HBOT which means a system which will automatically monitor the health parameter of the patient and make sure whether the patient is in the right condition to undergo it.

HBOT

Hyperbaric oxygen therapy (HBOT) is defined as treatment in which a patient intermittently breathes 100% oxygen, while the treatment chamber is pressurized to a pressure greater than that of atmospheric pressure (two or three times of atmospheric pressure at sea level) [1], [4]. HBOT is fascinating use of barometric pressure for delivering increased oxygen dissolved in plasma to body tissues. Therapy is given in special therapeutic chambers called hyperbaric chambers, which were earlier used to treat illness of deep-sea divers [5]. Committee on hyperbaric medicine defines hyperbaric oxygen therapy as, " A mode of medical treatment in which patient is entirely enclosed in a pressure chamber and breathes 100% oxygen greater than one atmosphere absolute (ATA). Considerably to the last decade, the understanding of HBOT mechanisms for clinical benefits has been increased. The critical issues in HBOT involve the failure of monitoring of patient's health parameters. It is important to understand health influencing parameters of the patient before undergoing hyperbaric therapy. The utmost intension of this project is to provide save pathway for HBOT, which means a system that automatically monitors health parameters of the patient and make sure whether the patient is in the right condition to undergo it. [5], [7].

ECG Module

Wireless biomedical sensors are promising alternatives to conventional, in hospital healthcare systems. Wireless ECG sensor system combines appropriate wireless protocol for data communication, with capacitive ECG signal sensing and processing as shown in figure 1. Capacitive ECG sensing is a simple technique that avoids direct contact with the skin and provides maximum convenience to user. ECG is one of the most widely used vital sign sensing and health monitoring methods and provides useful diagnostic information about cardiovascular system. [13]. Acquisition of ECG signals can be extended to single lead wearable patch, to perform patient monitoring at home or in any other nonclinical environments. Hence, we make implementation of adhesive ECG sensor patch, which is inexpensive, energy efficient, convenient and safe. A patch type wireless ECG measurement system is used to monitor daily life ECG and recorded using Smartphone or computer monitoring. Patch electrodes recording would be beneficial for long term monitoring of ECG and minimizes the effect of skin irritation and dehydration caused from long term use of gel electrodes. [12]. ECG monitors system based on Internet of Things (IOT), which calculates heart rate of the

patient and sends value of heart rate in bpm to a database cloud. Doctors can analyze real-time health related parameters of patients which are not admitted [14].

Heartbeat Sensor

Heart-rate measurement indicates the soundness of human cardiovascular system. In clinical environment, heart rate is measured under controlled conditions like blood measurement, heart voice measurement and ECG as shown in figure 1. A heart-rate measurement means to take samples of heartbeats, and compute beats per minute (BPM). Average resting human heart rate is 70-72 bpm in adult males and 75bpm in adult females [19]. There are two types of heart-beat measurements: one is using pulse oxi-meters and the other using IR sensors as shown in figure 3. IR sensors use photo plethysmography (PPG) method to measure the heart rate. Photo plethysmography is the process of optically estimating the volumetric measurement of an organ. When heart expands (diastole), the volume of blood inside the fingertip increases and when the heart contracts (systole), volume of blood inside fingertip decreases. Resultant pulsing of blood volume inside fingertip is directly proportional to heart rate. [16].

Fingertip Sensors

In fingertip sensors, IR transmitter/receiver pair is placed in closed contact with fingertip as shown in figure 2. When heart beats, the volume of blood cells under sensor increases and this reflects more IR waves to sensor and when there is no beat the intensity of reflected beam decreases. Pulsating reflection is converted to a suitable current or voltage pulses by the sensor. Thus, heartbeat signal is obtained by LED and LDR combination. Pulses from hands interrupts light reaching LDR and the signal is read by the microcontroller [18].

Respiration Sensor

Continuous monitoring of respiratory activities is necessary in clinical as well as in high risk situations (emergency) and appropriate monitoring equipment would be life saving. Hence non-invasive methods and devices are used which provides information about respiratory rate/depth or gas exchange. Normal adult human has respiratory rate of 12-15 breaths per minute at rest, inspiring and expiring 6-8 l/min of air. Oxygen enters blood and carbon dioxide excretes through alveoli. [29]. Respiration rate is one of vital sign which requires regular monitoring among diseased people. The main parameter used for measurement of respiration rate is temperature of respired air (inspired and expired). Hence, thermistor is used as source sensor which will provide temperature feedback of inspired and expired air. However, measurement of air pressure, using capacitor pressure sensor is robust and precise technique. In addition, a system that employs such transducers fall within low power consumption applications such as wireless sensor modes. Diaphragm capacitive pressure sensor (condenser microphone) is used to measure the respiration rate of patient. [21, 22], [30].

RFID

RFID (Radio Frequency Identification) system is one of the most pervasive computing technologies with technical potential and cost-effective opportunity in different area of applications are as shown in figure 3. It is low cost and has wide area of acceptability. RFID devices permit objects to be recognized with no visual contact and help in improving and automating a lot of process which includes metro cards, supermarket checkouts etc. RFID system is combination of tags, readers, communication protocols, computer networks and databases. [32, 33]. Many types of RFID exist, but we can divide RFID devices into two classes: active and passive. Active tags require power source - either connected to a powered infrastructure or use energy stored in an integrated battery. Passive RFID is of interest because they do not require batteries for maintenance. [34].

Pressure Sensor

Barometric MEMS pressure sensor must be calibrated at several temperatures and pressures. Barometric MEMS pressure sensors are used in mobile devices to determine relative height changes and absolute barometric air pressure as shown in figure 4. Most recent advances in silicon micro-machining technology have given rise to variety

of low-cost pressure sensor applications and solutions. Pressure sensor is a device that converts the applied pressure into proportional differential voltage signal. This output signal will vary linearly with pressure. [28, 38, 39] The BME280 is an integrated environmental sensor developed specifically for mobile applications where size and low power consumption is key design constraints as shown in figure 5. The unit combines individual high linearity, high accuracy sensors for pressure, humidity and temperature in an 8-pin metal-lid LGA package, designed for low current consumption, long term stability and high EMC robustness. [38, 42]. The new BMP280 is a barometric pressure sensor that is the next generation upgrade to the BMP085/BMP180/BMP183. The pressure sensor is an absolute barometric pressure sensor with features exceptionally high accuracy and resolution at very low noise. This sensor is great for all sorts of weather sensing and can even be used in both IC and SPI.

Supports Faster Wound Healing

Hyperbaric oxygen therapy can be a powerful tool in treating patients with stubborn, non-healing wounds. HBOT allows the body's natural, oxygen dependent healing process to work more efficiently in a 100% oxygen environment and can speed up the healing of wounds that have resisted conventional healing therapies. It enhances wound healing by vascular proliferation and cell multiplication.

Minimal or no side effects

Under proper supervision and the implementation of continuously updated protocols, the side effects associated with HBOT are very minimal. The most common side effect is ear discomfort. Clients are educated prior to treatment for prevention of ear discomfort. Clients are monitored closely for ear discomforts. Rarely, oxygen toxicity, pulmonary barotrauma and vision change can be experienced.

Simple and non-invasive

HBOT is a pain free, non-invasive treatment that has been proven to heal aliments and wounds that have been resistant to standard therapy. HBOT is a painless and non-invasive treatment.

Scope of the proposed method

Hyperbaric medicine includes hyperbaric oxygen treatment, which is the medical use of oxygen at greater than atmospheric pressure to increase the availability of oxygen in the body; and therapeutic recompression, which involves increasing the ambient pressure on a person, usually a diver, to treat decompression sickness or an air embolism by eliminating bubbles that have formed within the body. Internet of Things [IOT] can be used to link the module to the internet cloud. Thus, expanding the storage for patient data. More parameters like glucose and blood pressure [BP] monitoring can be included. HBOT is a rapidly developing treatment modality in various fields of dentistry.

Proposed Methodology

The proposed methodology for Hyperbaric Oxygen Therapy system comprises of multiple sensors interfaced to the controller are shown in figure 6. The automation in the proposed system is attained with the help of ARDUINO. ARDUINO MEGA 2560 is chosen as the core part of the proposed system unit because it integrates all the features necessary for the destined application. The system consists of sensors such as heartbeat sensor, respiration sensor, ECG module and pressure chamber. The authentication in the monitoring unit is based on the RF ID card. When a person tried to use the monitoring unit, initially he/she needs to swipe the ID card to the unit. The RF ID card reader reads the card and displays the details of the patient in the display. After affirmation, the patient will be subjected to monitoring. The ECG module interfaced to the controller will send the PQRST signal regarding the heartbeat of the person. The controller upon reception will display the info in the LCD. Precisely, the controller on reception of ECG makes use of its inbuilt ADC to convert the analogous data into digital one and display the data. The respiration sensor fed up the respiration status of the patient to the controller which on reception interpret the info and pass over to display. The heartbeat sensor will sense for the heartbeat level of the patient and send the info to the

controller. The controller on signal reception processes the information and displays it in the LCD interfaced to it. The pressure sensor will sensed the pressure and given to the voltage amplifier where the current driver will increase the input current and provide to the relay, where relay will act as a switch and Increase the supply current from current drive to Air compressor and provide the suitable pressure inside the pressure chamber which sense the pressure from the pressure chamber and convert it into the digital value which input has been given to the LCD and display the unit for the pressure.

RESULTS AND DISCUSSIONS

In order to develop a portable hyperbaric chamber for emergency, it is essential that the device is compact, lightweight, and easy to carry as well as to operate as shown in figure 7. If the device is cost effective, it is an added advantage. A chamber design, which includes an external oxygen supply, to provide 100% oxygen to the patient can make the device bulky and heavy, thereby making it less efficient as a portable device. Hence, a chamber needs to be constructed that provides a quick means of emergency treatment. This is achieved by excluding the external oxygen supply to the chamber but by retaining a hyperbaric environment inside the chamber. The number of sessions depends on the medical conditions. To benefit from hyperbaric oxygen therapy, we will likely need more than one session. Some conditions, such as carbon monoxide poisoning, decompression sickness, healing of wound etc. might be treated by HBOT. A clinical trial performed by our proposed system is represented below with help of a tabular column [1-4]. Few other cases are represented in the form of graphical analysis as shown in Graph [1-4].

CONCLUSION

HBOT was started as a treatment modality for management of decompression sickness. This System is safe to be applied on patients. The need is for naturally healing burns and wounds faster in patients. The chamber can be employed in emergency situations in public places. HBOT has the advantage to offer fast recovery as well as cost benefits. System is flexible and supports the therapy for entire body as well as for particular body parts. HBOT is witnessing a phase of phenomenal growth in the country.

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Table 1. Clinical Trial Performed by our Proposed System – Person 1 (Subject)

Name: **Person 1**	Age: **12 Years**	
Parameters	Before HBOT	After HBOT
Heart Rate (bpm)	78	74
ECG (Mv)	325	320
Temperature (°C)	29.15	30.15
Chamber Pressure (Internal) (Pa)	91075	91130
Respiration Rate (bpm)	16	15

Table 2. Clinical Trial Performed by our Proposed System – Person 2 (Subject)

Name: **Person 2**	Age: **25 Years**	
Parameters	Before HBOT	After HBOT
Heart Rate (bpm)	76	74
ECG (Mv)	335	327
Temperature (°C)	29.35	30.75
Chamber Pressure (Internal) (Pa)	91145	91192
Respiration Rate (bpm)	18	16

Table 3. Clinical Trial Performed by our Proposed System – Person 3 (Subject)

Name: **Person 3**	Age: **40 Years**	
Parameters	Before HBOT	After HBOT
Heart Rate (bpm)	72	70
ECG (Mv)	315	322
Temperature (°C)	29.35	30.75
Chamber Pressure (Internal) (Pa)	91190	91210
Respiration Rate (bpm)	19	17

Table 4. Clinical Trial Performed by our Proposed System – Person 4 (Subject)

Name: **Person 4**	Age: **33 Years**	
Parameters	Before HBOT	After HBOT
Heart Rate (bpm)	75	72
ECG (Mv)	357	348
Temperature (°C)	29.70	31.45
Chamber Pressure (Internal) (Pa)	91125	91153
Respiration Rate (bpm)	20	18

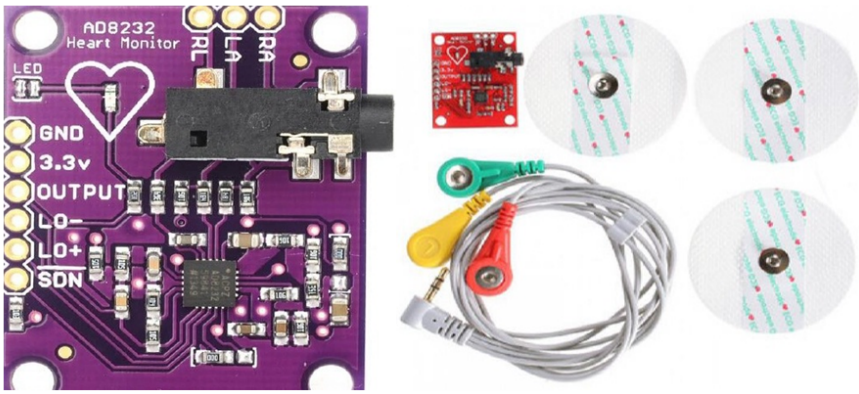


Figure 1: ECG Sensor Module & ECG Leads

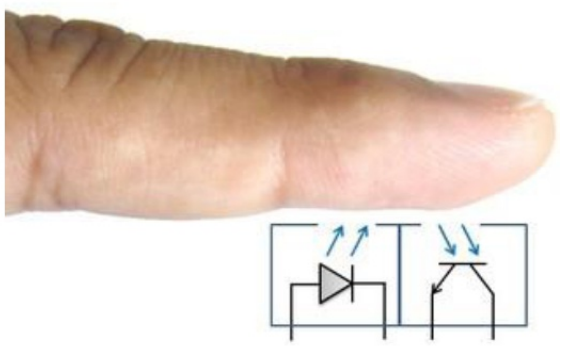


Figure 2: Infrared Fingertip Sensor with Transmitter and Receiver

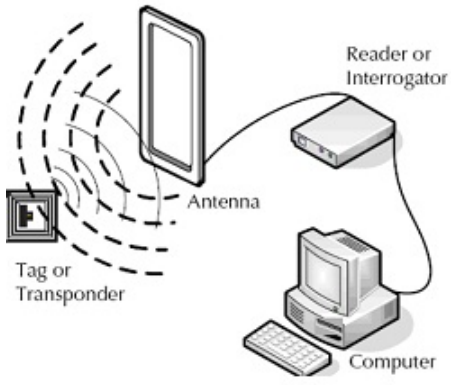


Figure 3: RF ID Reader and Card

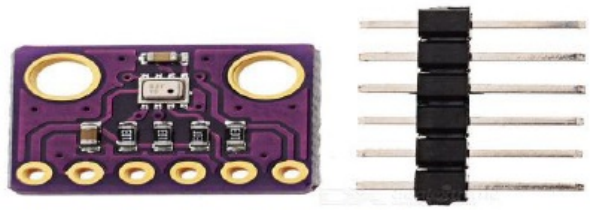


Figure 4: Pressure Sensor Chip

Figure 5: BMP08 Pressure Sensor

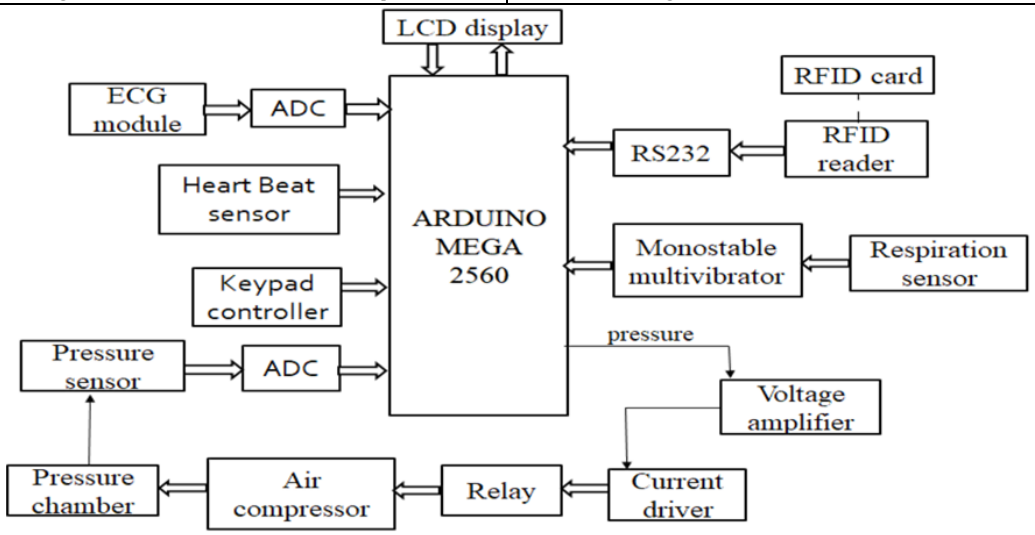


Figure 6: Proposed Block Diagram

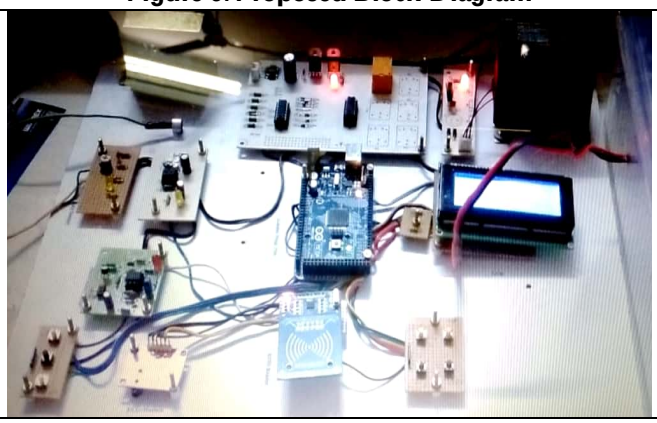
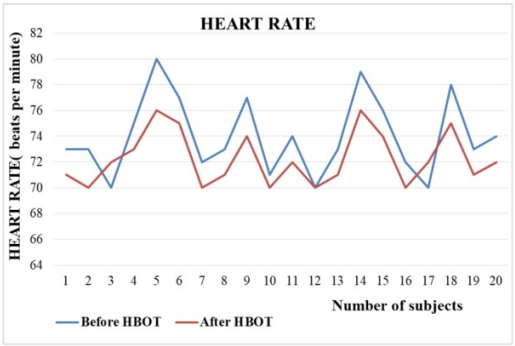
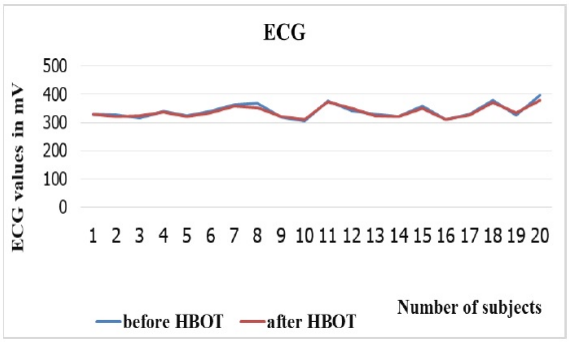


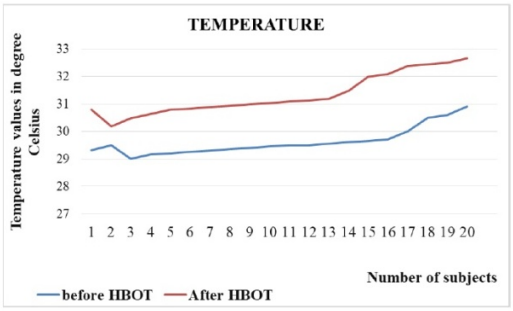
Figure 7: Proposed Method Prototype



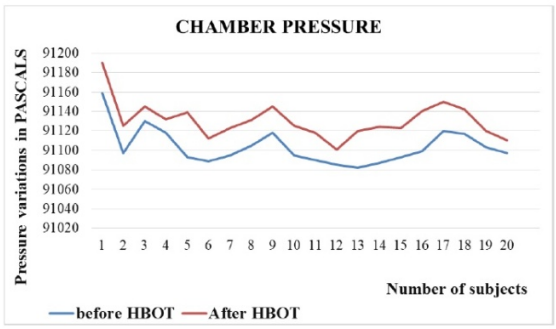
Graph 1: Number of Persons (Subjects) Vs Heart Rate (HR)



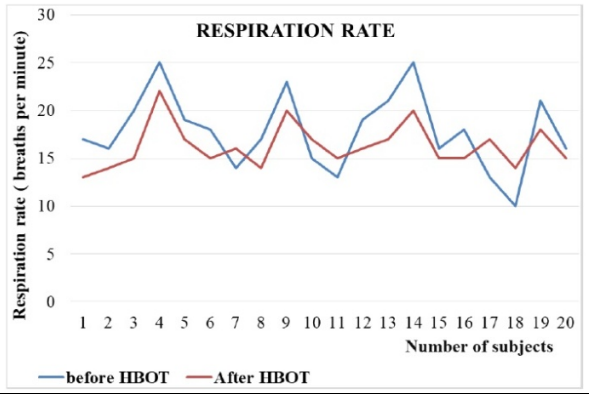
Graph 2: Number of Persons (Subjects) Vs ECG



Graph 3: Number of Persons (Subjects) Vs Temperature



Graph 4: Number of Persons (Subjects) Vs Chamber Pressure



Graph 5: Number of Persons (Subjects) Vs Respiration Rate

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RESEARCH ARTICLE

Artificial Intelligence (AI): A Novel Technique to Acquire and Utilize the English Language

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ABSTRACT

Artificial intelligence is continuously developing and changing, and there are strong indicators that the methods in which we teach and learn, as well as the educational instruments we use, will be fundamentally altered. There is a widespread notion that artificial intelligence relates to the collection and use of data. Although this is true, the primary goal of this article is to clarify the sci-fi setting and describe the most methodological approaches in which language instructors may use artificial intelligence into their English Language Teaching classrooms. An artificial intelligence based technology like language learning platforms provides teams with the ability to communicate at their own pace, identifying points in a conversation to return to and reinforce concepts that might be difficult for the group, making the most of the people's strengths, and bringing diverse cultural elements into the mix. Instructional data may provide educators with a bird's-eye view of their students' thoughts and future performance.

Keywords: Artificial Intelligence – Digital language learning – Technical advanced learning – Machine Language Learning – The Digital Teacher – Advanced Skills for Students.

INTRODUCTION

Artificial Intelligence has enormous promise, but when the term is presented in academic settings, it may be terrifying. Incorporating teacher supervision and creativity with artificial intelligence (AI) technological solutions may be a great tool for encouraging students' growth throughout their language learning experience [1,2].A powerful learning technology that uses artificial intelligence, such as language learning platforms, enables teams to communicate at their own rhythm, repeating topics and reinforcing concepts they have difficulty with, encouraging them to get involved in activities they are best at, and incorporating a variety of cultural aspects. Using data, instructors can learn what their pupils are thinking and how they will perform in the future [3-5].

MATERIALS AND METHODS

Artificial intelligence (AI) is having an impact on our day-to-day life. It is already being utilized in the manufacturing platforms, Electronic Commerce, and some other marketing industries. It's above time to begin using AI into foreign language learning and teaching as well [6]. We've been attempting to modernize the learning process using AI language learning for many years. However, nothing revolutionary has occurred in the business since the introduction of online learning. The use of neural network capabilities in conjunction with AI-powered language learning will renovate education for learners of English language and teachers as well [7]. Artificial intelligence (AI) has recently been recognized as a particular issue for teachers to deal with, according to a new UNESCO report. This article focuses on how instructors may utilize AI in the classroom [8]. The equipment available with integrated artificial intelligence allows us to delegate tasks that were traditionally handled by teachers and trust our pupils to do them. This encourages our students to assume greater responsibility for their study, while at the same time nurturing their independence.

It is an enduring struggle for both English Language Teaching and English as a Foreign Language; students and instructors at all levels of study to achieve understandable pronunciation in their respective languages. The good news is that there are free technologies accessible that may help both educators and learners in this area. Transcripts of speech may be generated, pronunciation can be verified, and voice commands can be responded. E-Learning algorithms based on artificial intelligence have the potential to improve eLearning in every area. Multinational companies may benefit from the usage of language learning solutions to improve the knowledge of their workers. Individual learners may leverage artificial intelligence literacy development to study whenever and wherever they choose. Traditional educational institutions may integrate artificial intelligence literacy development to broaden the education opportunities available to learners. The benefits of using artificial intelligence into eLearning are many and impressive. Teachers have a hard time finding the ideal strategy for all the students in a classroom. Thanks to the use of AI, each student's specific requirements may be accommodated. Using AI, instructors may get massive amounts of data on learners, including their interests, skills, and other characteristics.

When it comes to screen time for children, educators, psychologists, and parents are still debating whether or not it is appropriate. However, artificial intelligence is beginning to alter education tools and institutions, in the form of a further advanced technology and shaping the bright future of the education. Despite the fact that the majority of experts think that instructors are irreplaceable in the classroom, numerous changes will be made to the work of a teacher as well as to educational best practices. Artificial intelligence has already been used to education, mainly in the form of aids that assist in the development of skills and assessment systems. As artificial intelligence (AI) educational solutions keep developing, the goal is that AI will be able to bridge the gap in acquiring knowledge that now exist, allowing schools and instructors to do more than they have in the past. AI may improve efficiency, customization, and administrative chores, giving instructors more time and flexibility to focus on providing understanding and adaptability—capabilities that are uniquely human and those robots would struggle to replicate. By combining the finest characteristics of machines and instructors, the vision for artificial intelligence in academia is

one in which they collaborate to achieve the greatest possible result for pupils. Because the learners of today will be required to work in a world where artificial intelligence is a reality, it is critical that contemporary educational institutions familiarize them to and encourage them to utilize the technology. Since the beginning of time, educators have prioritized customizing education for each student's unique requirements. Artificial intelligence will provide a degree of differentiation that is unachievable for instructors who have to handle more students in each class. Soon enough, it will be feasible for a computer to decipher when a student's expression reveals that they are having trouble comprehending a concept and alter a lesson to meet their needs. While this concept of tailoring education to the requirements of individual student cannot be done with current technology, it will be possible with AI-powered machines [9].

With the assistance of artificial intelligence technologies, schools that can be used by people who speak various languages or who are visually or hearing impaired may be provided to the whole global population. The effective tool of artificial intelligence, Presentation Translator is a free PowerPoint add-in that instantaneously generates subtitles while the instructor is speaking. This will also make the path accessible for kids who can't attend school because of infirmity or who need additional learning on a topic not offered in their school. Using AI, we can break through the barriers between conventional grade levels and secondary schools. It takes a lot of time evaluating homework and exams for an instructor. While also time providing advice on how to bridge the gaps in knowledge, AI can easily do these jobs. However, computers are now very capable at grading multiple-choice exams. The introduction of AI into administrative duties increases the amount of time instructors have to engage with each student. The field of artificial intelligence has the promise of improving enrollment and admissions procedures [10].

It was impossible to expect artificial intelligence to be used to a static area of knowledge and come up with a novel answer. Artificial intelligence (AI) has the potential to be the most effective instrument for learning the global language that built on fresh learning methods for learning and teaching English abilities. Although artificial intelligence is capable of performing automatic valuation of written and spoken content and giving response to the language learners, it is still perplexed whether fixing errors in pronunciation, sentence structure and grammar is beneficial when learning English as a second language. There is a misconception that students may learn through mistake correction. This is due to the fact that the errors are generated automatically and would be repeated until the students' English abilities improved. When learners undergo subconscious training, they develop the capacity to communicate spontaneously and without making any mistakes. It is possible to build a customizable arena in which language teachers may utilize all of their perceptions to concurrently develop English skills in accordance with their present level of English, occupational requirements, or hobbies, thanks to artificial intelligence. However, keep in mind that the use of an artificial intelligence robot's synthetic voice should be limited to instructions and recommendations, whereas the majority of lessons and exercises should be registered by native English people because the expressive factor of a human voice is mandatory for the intuitive training of acceptable pronunciation. The genuine content of native speakers ensures the lessons afford by artificial intelligence to language learners are effective. It was not possible to apply artificial intelligence to a static field of learning and expect it to provide a novel answer.

CONCLUSION

Artificial intelligence (AI) has the potential to be the most effective instrument for learning English, provided that learning methods. As the globalization of the workforce continues, the ability to communicate effectively in English is becoming more essential for technical students. Employees and students in many technology firms and engineering programs at universities are expected to have a working knowledge of technical English. Fortunately, there are a variety of applications available that may assist non-native English speakers in becoming more proficient in the English language. AI and machine learning are used by some of these language learning applications, such as Duolingo, to facilitate teaching a foreign language simpler and more productive. There are a variety of additional

excellent methods for engineers to improve their English communication abilities. Following up on a recent article, viewing English-language television programs, listening to English-language podcasts, reading books published in English, and listening to English e-books are all enjoyable methods to enhance your English language skills during your free time.

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REVIEW ARTICLE

Resealed Erythrocytes: A Review

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ABSTRACT

The term drug delivery refers to the administration of a pharmaceutical compound to humans or animals to achieve a therapeutic effect. A drug delivery system enables the pharmaceutical compound to reach the site of action selectively. Modern science has invented several types of drug delivery systems like Liposome, Niosome, Nanoparticles, etc. Resealed erythrocytes belong to the category of novel drug delivery systems. They have the specialty over other discovered delivery systems because they can overcome some of the disadvantages possessed by others. Simply resealed erythrocytes are ideal drug delivery systems. Preparation of resealed erythrocytes requires extreme care and simply includes the collection of erythrocytes, entrapping the drug, and then resealing it. For drug entrapment several methods like hypotonic hemolysis, isotonic osmotic lysis, chemical perturbation, and electro insertion are used. Resealed erythrocytes have a wide range of applications in drug delivery. Many companies are trying to get the marketing approval for their products which are meant for treating severe diseases like cancer and most of them are under clinical studies. Even though the development is risky resealed erythrocytes is a promising drug carrier system.

Keywords: Resealed erythrocytes, Drug delivery system, Carrier, Novel drug delivery, Drug targeting, Drug entrapment.

INTRODUCTION

Drug delivery is a term that refers to the administration of a pharmaceutical compound to achieve a therapeutic effect in humans or animals [1]. Several routes or methods are being used to deliver the drug and these methods affect the performance of the drug. Very slow progression in the treatment of severe diseases leads to the development of the concept 'Drug delivery systems.' By controlling the pharmacokinetics, pharmacodynamics, immunogenicity, and biorecognition drug delivery systems were able to prevent harmful side effects with more bioavailability. Controlled and novel drug delivery systems were a dream before and have become true now [2]. Drug delivery systems can be implants, microchips, nanoparticles, liposomes, etc. And all these can ensure the availability of drugs at the site of action to meet the need of a patient for the intended duration [3]. Instead of all the benefits most of them possess some disadvantages also. This includes clearance by the reticuloendothelial system, accumulation of lipids in liver and spleen in case of lipid nanoparticles, change in drug release profile due to lipase degradation, macrophage drug clearance, etc [4]. All these may be due to the reason that the drug delivery system has been made with foreign materials. Here comes the importance of resealed erythrocytes as a drug delivery system. Being the part of our body erythrocytes are non-immunogenic and their clearance is also less. They can circulate throughout the body also. In this article, a summary including advantages, disadvantages, method of preparations, applications, and current status on market entry of resealed erythrocytes have been mentioned.

Resealed Erythrocytes As Drug Delivery System

Advantages of using erythrocytes as drug delivery system;

1. Erythrocytes are capable of transporting a wide variety of biologically active compounds naturally throughout the body and these compounds are either loaded onto the surface or into the inner volume [5].
2. Since they are part of the body, they are non-immunogenic, biodegradable and there is no generation of toxic products [6,7].
3. Erythrocytes are very easy to isolate and entrapment of a variety of compounds in large amounts is possible [7].
4. This kind of drug targeting provides opportunities to target intracellular pathogens and develop new drugs [8]. (5) Also resealed erythrocytes can circulate throughout the body and can target specifically within the reticuloendothelial system.
5. By loading inside the erythrocytes premature degradation of enzymes and proteins can be prevented [9].
6. Proteins can be loaded into the erythrocytes particularly if their site of action is either spleen or liver and are used to treat disorders such as Gaucher's disease [10].
7. The plasma level of most of the drug can be sustained by entrapping in the erythrocytes. This will reduce the frequency of injection also [11].
8. Erythrocytes are having almost uniform size, shape, and relatively inert intracellular environment [12].
9. Expecting zero-order drug release from erythrocytes.

Limitations of using erythrocytes for drug delivery

1. The most reported one in using natural carriers for drug delivery is the in vivo clearance by the reticuloendothelial system [9].
2. Dose dumping can be a problem.
3. Storage of loaded erythrocytes is another problem.

Methods of Drug Entrapment in Erythrocytes

Hypotonic Hemolysis Method

The erythrocytes are having an interesting property of reversible shape-changing under stress conditions which are utilized for this method of drug entrapment. The surface area of erythrocytes is fixed and so any increase in volume will lead to a change in the shape from biconcave to spherical. But there is a limiting capacity for the erythrocytes to expand their volume. When the volume increases 50-70% of the initial volume and if placed in a solution less than

about 150 m-osm,Kg the membrane ruptures. This is the point at which the intracellular components are escaped from the erythrocytes, at the same time the extracellular substances can enter into the erythrocytes. Now the erythrocytes can be resealed by increasing the salt concentration back to the initial level. The extracellular substances entering the erythrocytes can be low molecular weight drugs, macromolecules like proteins, enzymes, and even viruses [13]. Hypotonic hemolysis can be achieved by 3 methods, hypotonic dilution, hypotonic pre swelling, and hypotonic dialysis.

Hypotonic dilution

In this method, the freshly collected erythrocytes are washed with 0.9% sodium chloride solution. Then an aliquot of the packed cells is diluted with the solution of drug,enzyme to be entrapped. The tonicity of the solution is restored by adding a hypertonic buffer such as 0.9% sodium chloride [14]. The erythrocytes are obtained as pellets after washing several times with isotonic buffer solution [15]. The drawback of this method is low entrapment efficiency and high loss of hemoglobin from erythrocytes. This may reduce the circulation half-life of the resealed erythrocytes also [6].

Hypotonic preswelling

As the name indicates the method is based on initial controlled swelling of the cells in a controlled buffered solution [6]. A hypotonic modified Hank's balanced salt solution (HBSS) can be used for this purpose [16]. The cells are allowed to mix with HBSS by inversions of the test tube several times followed by centrifugation for 5-10 minutes at low g values. The supernatant is discarded leaving the swollen cells in the test tube. A layer of lysed cells occupies the surface of the cells that act as a barrier to the drug to be entrapped. This prevents any high osmotic or chemical shock to the cells. The aqueous solution of the drug is to be added to this hemolysate layer. And the process of inversion, centrifugation, and addition of drug solution is continued until the cells reach the point of hemolysis which is indicated by a rapid increase in the transparency of the suspension and darkening of the hemolysate layer. At this point, the erythrocytes are resealed by the addition of HBSS at 10 times initial eutonic strength [17]. Suspension is treated with PBS to remove the released hemoglobin from lysed cells and the unentrapped drug [18].

Hypotonic dialysis

This method of encapsulation was proposed in the 1970s. Dialyses results in cell swelling and an increase in porosity due to the hypotonic environment and thereby allow substances to enter the red cells. The method employs a dialysis bag containing drugs to be entrapped with the hypotonic buffer. Erythrocytes are subjected to osmotic shock by this hypotonic buffer that results in the formation of pores on its surface. The drug present in the dialysis bag passes into the bag by a passive mechanism. To close the pores and keep the drug inside the erythrocytes, normal osmotic conditions are established back [19]. The non encapsulated drug was removed by washing three times in PBS buffer [20].

Red cell loader

Red cell loader is an easy-to-use, non-invasive and automatic bedside medical device used to load erythrocytes. Therapeutic enzymes, recombinant proteins, etc can be loaded by using this technique. Then the sealed erythrocytes are reinfused to the body which provides better tolerability, reduced immunogenicity, and long circulation half-life [21]. This apparatus was introduced by Magnani and coworkers in 1998 as a novel approach for the entrapment of non-diffusible drugs into human erythrocytes [22]. By using a red cell loader they entrapped a variety of biological compounds into erythrocytes in a small quantity of blood say 50ml. This was done for a duration of 2 hours at room temperature under blood banking conditions. The method involves sequential controlled hypotonic dilutions of washed red blood cells followed by concentration with a hemofilter. Subsequent isotonic resealing of erythrocytes leads to up to 30% drug entrapment [6].

Isotonic osmotic lysis

The method includes placing erythrocytes in a substance solution that can permeate into the erythrocyte membrane [9]. This diffusion is due to the concentration gradient. This is followed by the influx of water to correct the osmotic

equilibrium [12]. An osmotic solution of ammonium chloride can be used for this purpose [23]. Other substances used are PEG and urea solution.

A.V. Chernyshev et al used this method for encapsulation of erythrocytes. 5µl of blood was mixed with 1ml of lysing solution (isotonic concentration of ammonium chloride in degassed water with 1.5mM buffer HEPES and known concentration of sodium bicarbonate) in a test tube. The solution was prepared before conducting the experiments and homogeneity of suspension was ensured by pipetting the sample. The solution was kept under gentle agitation during the course of the experiment [23].

Chemical perturbation of the membrane

Chemical perturbation is the method in which erythrocytes are subjected to some chemicals that will cause changes in the membrane permeability of erythrocytes. It is utilized for encapsulating the drug substance [9]. R. Gabbianelli et al conducted a study using male Wistar rats in which cypermethrin is utilized for inducing permeability changes [24]. Similarly, Fenvalerate and its metabolites are used to induce perturbation [25]. The process of phosphorylation has been proved to have a role in the perturbation of the multiprotein complex of the erythrocyte membrane [26]. R. Gabbianelli et al dissolved cypermethrin in corn oil and administered it at a dose of 12.5mg,kg body weight per day for 60 days using the intragastric tube. Treatment was done every morning in non-fasted rats. They found that cypermethrin produces oxidative stress on the plasma membrane of the erythrocytes [24].

Electroinsertion

Electric pulses are utilized to make pores in the erythrocytes. A field strength below the critical field (Ec) is used to create the pores in the membrane that are hydrophilic. And a hydrophobic protein can get inserted into the membrane at this stage [27]. This will not cause any damage to the cells [28]. Also, electroporation does not alter the life span of RBC [29]. The process includes the application of the electric field for the only duration of milliseconds in presence of the protein to be enclosed [27]. The change produced by electric shock in the membrane is reversible. The pores are resealed by incubating at 37°C in an isotonic medium [28].

Endocytosis

Endocytosis is another means of loading erythrocytes and is used in conditions where hypotonic hemolysis is not applicable. For example, situations like an encapsulation of DNA or particles as large as bacteria. Erythrocytes loaded by endocytosis show different invivo survival characteristics from that of other resealed erythrocytes due to the presence of vacuoles [13]. Shrier et al studied drug entrapment in erythrocytes ghosts by the endocytosis; in which one volume of packed erythrocytes is added to nine volumes of buffer. The buffer is composed of 2.5mM ATP, 2.5mM MgCl2 and 1mM CaCl2. Mg-ATP is the essential substrate requirement for endocytosis [30]. Usually, a concentration of 4-10mM Mg-ATP is required. Upon incubation, within 30 minutes about 45% of the RBC surface membrane is removed and get convert to sealed inside vesicles [31]. Neonatal RBCs have an enhanced capacity to undergo endocytosis [32].

Loading by electric cell fusion

A low-intensity non-uniform alternating electric field is applied initially to the cell suspension to brought cells very close. Fusion is achieved by applying an electric pulse just for the 20-50µs duration. The electric pulse should be such that it can induce a reversible breakdown of the fused membrane [33]. The applied electric field induces an electric breakdown of the cell membrane which in turn produces membrane pores [34]. Electric cell fusion has the advantage of reducing the fusion moment to small fractions of a second and results in high entrapment yield [35]. A cell fusion chamber is used for the process. It consists of 2 parallel platinum wires that servers as electrodes. Electrodes are placed in between 2 glass coverslips which are separated by a nonconducting spacer. Now the red cells suspended in a fusion medium are to be placed in the space between electrodes and the electric field is applied to allow the fusion [34].

Applications of Resealed Erythrocytes

Red calls can be used to encapsulate a wide range of drugs including nucleic acids and peptides. Drugs that leak rapidly from the erythrocyte membrane and those that are toxic to the red cell are not suitable for this kind of delivery. Prodrugs can be efficiently delivered via erythrocytes due to the presence of some resident enzymes in red cells that convert the prodrug into the active form [36]. The active form can pass through the erythrocyte membrane into the bloodstream [37].

Delivery of peptides

Enalaprilat is a peptide-like drug belonging to the category of angiotensin-converting enzyme inhibitor. Its prodrug enalapril is orally absorbable and is used to treat hypertension and congestive heart failure [38]. Hypotonic preswelling method was used to load enalapril into the erythrocytes and evaluation of drug-loaded red cells revealed considerable loading parameters along with a zero-order release of the drug. However, the effect of some irreversible changes of erythrocytes caused by the loading process on therapeutic efficacy and safety of such delivery system is not well understood [39].

Glutathione (GSH) is a naturally occurring non-protein thiol that plays a protective role against oxidative stress [40]. GSH has control over the reactive oxygen species (ROX), the main contributor to oxidative stress and pathologies of different diseases. A reduced level of glutathione will be a favorable condition for ROS and diseases including HIV, cystic fibrosis, cancer, etc [41]. GSH loaded erythrocytes were able to provide protection for macrophages and prevent LP-BMS infection in the brain. A combination of two nucleoside analogs AZT+DDI with GSH loaded erythrocytes are proved to be most effective in providing brain protection [42].

Delivery of proteins

Erythrocytes are successively employed to carry insulin for the treatment of type 2 diabetes mellitus. The hypotonic preswelling method was used to load the insulin in erythrocytes. The insulin-loaded erythrocytes were tightly attached with biotin modified GOx on their surface and injected into blood circulation. The system is off until the blood glucose level rises. When the glucose level becomes high the GOx converts it into gluconic acid and hydrogen peroxide. A higher concentration of hydrogen peroxide at the proximity of erythrocytes causes rupture of the RBC membrane and the system becomes on. The loaded insulin is released through these pores and decreases the glucose level back to normal. The low level of hydrogen peroxide then reseals the erythrocytes [43]. Erythropoietin is a glycoprotein having a great role in erythropoiesis. It has been demonstrated that erythropoietin can be loaded into erythrocytes for its in vivo protection from premature degradation as well as to facilitate widespread distribution [44].

Delivery of enzymes

The enzymes loaded into erythrocytes can be used to treat several disorders resulting from the deficiencies of corresponding enzymes, inborn disorders due to deficient enzymes, etc [37]. L- Asparaginase (ASNase) is an enzyme that hydrolyzes L- Asparagine to L- aspartic acid and ammonia. In disease conditions like acute lymphoblastic leukemia, a lower expression of the enzyme is reported. A protein transduction domain (PTD) mediated cell internalization was used to load ASNase to erythrocytes. Treatment using such a system improved survival time in lymphoma-bearing mice [45]. The resealed erythrocytes act as a slow-releasing vehicle for enzyme delivery [46]. Alcohol dehydrogenase and aldehyde dehydrogenase are enzymes responsible for the metabolism of ethanol produced by the liver and is having a significant role in treating ethanol intoxication [47]. Electroporation was used to incorporate the enzymes into erythrocytes. The experimental parameters related to electroporation were systematically studied and the process was optimized to ensure better encapsulation efficiency. The electroporated red cells were successful in lowering the level of ethanol concentration in the intoxicated mice [48].

Delivery of glucocorticoids

Glucocorticoids have a short half-life and so there is a need for frequent administration which increases the toxic effects. An approach that can prolong the half-life or promote the slow release of the drug will enhance the efficiency

of treatment. Erythrocytes are such an approach. Patients with COPD were treated using erythrocytes loaded with dexamethasone and found to be effective as a slow-release drug delivery system [49].

Antiviral drug delivery

Erythrocytes help in the selective delivery of antiviral drugs to macrophages. The drug-loaded erythrocytes are opsonized by IgG and C3b deposition which allow the macrophages to recognize and phagocytose these erythrocytes. Through this mechanism, antiviral agents like reduced glutathiones can be delivered selectively to the macrophages [50].

As a diagnostic agent

Erythrocytes are used as a diagnostic agent in nuclear magnetic resonance spectroscopy by loading it with Gadolinium DOTA [51].

Current Status on Market Entry of Resealed Erythrocytes

Resealed erythrocytes have been proved to be useful as drug delivery systems and are currently undergoing clinical trials for marketing approval. GRASPA, L- Asparaginase encapsulated within erythrocytes is a product of Erytechpharma. L- asparaginase is an enzyme derived from E-coli and is a promising aid in acute lymphoblastic leukemia [52]. Due to side effects when used with other chemotherapeutic agents other formulations were derived like pegylated asparaginase. But it was not completely satisfactory. And this leads the way to the discovery of erythrocyte-loaded asparaginase. Erythrocytes enhanced the half-life of asparaginase and also reduced the occurrence of side effects. The phase I,IIstudies revealed that one single injection of 150 IU,kg of GRASPA has an activity similar to 8 injections of 10000 IU,m2 of native E coli L- asparaginase. But the marketing authorization letter was withdrawn by the company on 14 November 2016 as they were not able to provide the additional information sought by Committee for Medicinal Products for Human use (CHMP) [53].

Erydel, Italy has developed Erydex which is dexamethasone-loaded erythrocytes. It is proved to be effective for neurodegenerative disease, Ataxia-telangiectasia (AT). Clinical trials were started in the year 2013 and the disease was found to be improved in young patients with 6 monthly infusions of Erydex. Extended studies showed a continuous neurologic improvement and the drug is soon to be on the market [54]. Erytechpharma is developing Enhoxy, erythrocyte loaded with inositol hexaphosphate and can release more oxygen from red blood cells. The committee for Orphan Medicinal Products of the EMA recommended orphan drug designation for Enhoxy on 13 June 2012. Another company named Orphan Technologies Ltd has acquired the license for developing drug-loaded erythrocytes for the treatment of severe combined immunodeficiency [55].

CONCLUSION

Due to the ability of resealed erythrocytes for target-specific drug delivery they are becoming the new trend over other carrier systems. Although the manufacturing method looks somewhat tedious the system is a promising aid for routine drug delivery in the future. Resealed erythrocytes become an ideal delivery system as they are biocompatible, biodegradable, and easily available. The controlled and, or targeted release of the therapeutic compound is the major attraction of this drug delivery system. The application of resealed erythrocyte as a drug carrier has been proved to be suitable for many drugs and several drug molecules including drugs for severe diseases like cancer have been successfully encapsulated in erythrocytes. The clinical efficacy of such encapsulated formulations is under evaluation. Once it is approved for marketing a remarkable advance in drug delivery can be expected with minimization of toxic effects. By considering its potential the International Society for the use of Resealed Erythrocytes has been concluded that erythrocyte carriers are ‘golden eggs for novel drug delivery.

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RESEARCH ARTICLE

Analysis of Product based Profit Outcome in Home Textile Industry using Linear Programming

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ABSTRACT

Many businesses were founded, and continue to be founded, for the purpose of generating financial profit. As a result, the primary goal of such enterprises is to maximise (optimise) their profit margin. The purpose of this study is to determine the most profitable method of producing clothing bags for the Karur-based home textiles company by employing the Linear Programming Technique. The Linear Programming of the company's operations was developed, and the best possible results were obtained through the use of software that utilised the Simplex approach. The findings indicate that two specific things should be manufactured even if the company is required to meet the demands of other – less profitable – items in the immediate vicinity of the manufacturing plants.

Keywords: Home Textile sector, Linear Programming, Resource Utilization, Optimal Solution, MS-Excel Solver.

INTRODUCTION

In human life, the influence of fabrics gains significance always, even from the beginning stage of the human era. Fabrics are the essential material without which the individual and group of humans can't lead a societal life. In general, fabrics are not only the materials used as the wearing of humanoid, rather they played many significant roles help to lead a comfortable lifestyle. In the earlier days, the usage of fabrics was limited for few purposes like dress material, etc. but the development of civilization takes the human lifestyle to become modernised and lead to be used in every part of human life structure. Nowadays, the style and structure of human life have been modified tremendously. Everyday life of a person has categorised into many divisions as official, personal, etc., based on their interests, clan, and cultural background. For every style and part of life, the individuals essentially required, apart

from many other things, different variety of textile and fabric materials. In recent days, the lives required variety of fabric elements for usages and thereby its market and business also increasing substantially.

Home textile is a term to be used to describe the fabric items to be used especially for the purpose of home furnishing and its relative works. The design and the manufacturing methods are mainly based on functional activities. In general, the term home referred to be a place for rest having a geometrical flat structure with floors, roofs, windows, and doors. The fabric material used for designing the interior of home furnishing also comes under the category of home textiles. Thus, the home textile includes the fabric materials designed for the interior of the home, used for the house functional utilities, etc. also can be classified as home textile. The purpose of fabrics for home interior design is also purposed to control the light, noise to update the living or working condition. In this context, materials manufactured are focused to develop with a variety of colours, material combinations, textures, designs, etc., and its marketing demand also increasing based on their fashion and finishing. Marketing of home textile is unique and different from other variety of apparels. Manufacturing industries making home textile products find the business entirely different from other fabric apparel sectors. Manufacturing of home textile apparel is not season-based and marketable even throughout the year. More than 24 variety of products such as table cloth, window curtains, aprons, doorstep mat, comes under the business category of home textiles. Each variety has individual demands dissimilar with other items and hence, the business is also different. This includes every item and its demand, manufacturing cost and time, labour availability, etc. As the items, each factor is different for each item and hence the business promotional activities are not same to proceed in common and hence, individual formulations are essentially required.

To accelerate the business activity of each item, a detailed analysis is required which includes the item details and their productional cost and demand, etc. Mathematical formulations are one of the promising ways to analyze business aspects of an industry. This methodology can be used to explore the possibility of maximizing the profitability of the business or minimizing the limiting factors of the business profit. Linear programming problem is one of such tools that can be used to explore the maximization of business promotional aspects. This could possibly analyze the business activities of the home textile apparel and enhance the profitable processes. In the present work, a detailed analysis of the home textile apparel has been done on every item to address the business promotion possibilities of such items. Linear programming problem (LPP) has been chosen as a tool to explore the ways to enhance the business to become profitable by minimizing the limiting factors. In this method, the demand for every item and its productional aspects are taken into consideration for the analysis.

Present work is to explore the profitable business processes in the textile industry and to maximize the profit by enhancing the appropriate decision-making in the business proceedings. In the textile business sector, various firms on various bases were engaged. Fabric manufacturing is the core process carried out by many industries while, the raw material development such as yarn, thread manufacturing is entirely organized in different firms. The manufacturing of dress material apparel is another sector that comes under the broad business sector of the textile industry. Present work is also planned to promote the business trend in a profitable fashion on the basis of mathematical formulations. Linear programming problem (LPP) is a familiar mathematical tool that can be used to formulate the mathematical equations for decision making towards maximizing the business profit and reduce the production cost and loss, etc. Since the mathematical formulation is a core of the work and being an essential part, a detailed survey of the literature is also to be undergone in the publications of LPP formulated business works. This work is an acknowledgment of LPP formulated business sectors developed to enhance the business activity and to reduce the cost and loss, as follows:

In the year 2018, Campo EA et al., [1] has published the work as a proposal for the implementation of the production planning model in aggregate and analyzed the optimal strategies in the textile firm particularly in the range of medium-term. This work has concentrated on minimizing the cost applied for labour category at the inventory level. This work also accounts for the introductory effects of new employees and trainees in the business firm. The author also focused their interest on the material properties also. They have reported the influence of material/ fabric

contraction and waste in business and production effectively. The authors reported the use of LPP mathematical formulation for identifying improvement strategies for the increase of production and storage for attaining profit at lower expenses. The authors also acknowledge the help of mathematical formulations for effective decision-making and to obtain quantitative results at the formulation level. Research group of Eshetie Kassegn et al., [2] employed a case study for planning the profitable textile business process using the Linear Programming model in the year 2016. The author focused on a particular factor by employing several constraints for the maximization of profit or minimization of loss by applying the LPP model effectively. For this objective, they have taken the various segments of the business market into considerations, utilisations of machinery tools, interests of workers, present and forecasting business demand and resource management, etc. As result, the authors acknowledged the successful application of the LPP model for attaining the appropriate business solutions towards profitable developments. They have reported the quantitative figures of profit in the textile forms in particular by employing mathematical formulations and modeling.

Tsegay[3] has analysed and reported the importance of decision-making in the reduction of production costs and waste materials. In the year 2013, he explored the possible solutions for promoting business profit, particularly in the textile sector. He analysed the development of the textile business and its influence, particularly in Ethiopia. He acknowledged the effective role of cotton textile manufacturing and marketing in this selective region of study. The author observed the successful growth of the textile market and manufacturing and their potential increase in the recent times of analysis. In this analysis, the author employed a Linear programming model for making the results effectively and helps to arrive at an appropriate decision at the designated time. He recommended the capacity planning for a successful run of the textile firm in Ethiopia. Tsegay is the analyst who used the LPP model to identify the influence of wastes in affecting the business of textile units and its effect on cost-effective business promotions.

Ayhan Yalcinsoy et al.,[4] explored the effective role of the factor, Time. The team of authors explored the significance of time, an important factor, in strategic decision-making and planning. The author team also analysed the influence of the time factor with the help of LPP modeling and explored the importance of capacity planning. This analysis also narrowed down their view up to the fundamental process of works such as cutting, packaging, etc. in promoting the functional processes towards profitability. Woubante G. W. (2017) [5] reveals the strategy used for industrial development using by accessing the resources effectively at various production stages. The author claimed linear programming problem is a quantitative decision-making tool. In such a way, he explored the promising efficiency of the LPP model helpful for business development. In this work, an LPP model has been developed including the detailed parameters of product volume, resource content, production parameters, and profit of each unit. The author explored the possibility of profit enhancement of more than 7 % only with the help of LPP formulations. S.C. Bhatnagar, [6] has derived the problems and solutions based on the idea to promote the textile-based firm by formulating a mathematical idea and executed in Linear Programming Problem (LPP). In this work, the author analysed in detail the planning and methodology of a textile firm. He also discussed the significance of mathematical formulations and their variation from manual methods. He revealed and explored the details of LPP formulations and their effective usage in developing cotton-based textile industrial processes.

METHODOLOGY

A review of related literature was conducted in order to have a better understanding of India's industrial development plan and the priority areas in the country's economic growth process. A linear programming technique was proposed in order to achieve optimal resource utilisation and profit for the country's prioritised economic sectors to bring about national economic development through those sectors. It was decided to use one of the home textile production enterprises in India as a case company in order to demonstrate how the methods recommended can be utilised. The following information has been acquired from this instance company: six different types of products that the company is currently making, the number of resources that are required to create each unit of the products, and the profit per unit that may be generated from the sale of each product. It was also obtained from the case company information on the monthly availability of each of the organisational resources (fabric, cotton ropes,

yarn, zippers, and snap buttons), as well as information on the monthly production volume of each of the six items. This mathematical model was created by applying a general linear programming methodology (setting of goal function, constraints, and non-negativity limitation), which was applied to the data received from the company and entered into its mathematical model. For the purpose of solving the mathematical expression (i.e., the mathematical model produced for the case company), the linear programming technique implemented in MS-Excel was utilised.

Linear Programming Model of the Company

Maximize Z = 103.50X1+182.36X2+100.33X3+141.29X4+176.14X5+194.03X6

Subject to

$524X1+ 529X2+ 501X3+ 633X4+ 851X5+ 880X6 \leq 35{,}653{,}800$

$7.10X1 + 7.50 \quad X2 + 7.90X3 + 8.90X4 + 10.60X5 + 11.08X6 \leq 483{,}028$

$183X1 + 185X2 + 187X3 + 192X4 + 202X5 + 205X6 \leq 10{,}501{,}400$

$X1 + X2 + X3 + X4 + X5 + X6 \leq 54{,}600$

$4X1 + 4X2 + 4X3 + 4X4 + 4X5 + 4X6 \leq 218{,}400$

and

$Xi \geq 0, \text{ for } i = 1, 2, 3,...,6$

Where,

X1 = Garment Bag 60 x 110

X2 = Garment Bag 70 x 110

X3 = Garment Bag 50 x 140

X4 = Garment Bag 75 x 140

X5 = Garment Bag 65 x 200

X6 = Garment Bag 65 x 212

ANALYSIS AND RESULT

Optimal solution: Objective function value = 10,115,461

Interpretation of Result: Based on the data gathered, the optimal findings given from the model recommend that two items, a garment bag 70 x 110 and a garment bag 65 x 212, should be manufactured and distributed. Their total production amounts should be 41,009 and 13590 units, according to the estimates. It is possible to make a maximum profit of Rs. 10,114,541 by doing so.

CONCLUSION

According to the findings of this study and the conclusions reached, Home Textile Company, Karur should manufacture garment bags in the following sizes: 60 x 110, 70 x 110, 50 x 140, 75 x 140, 65 x 200, 65 x 212, but more garment bags in the following sizes: 70 x 110 and 65 x 212 in order to satisfy their customers: 70 x 110 and 65 x 212. Additionally, more garment bags 70 x 110 and garment bags 65 x 212 should be manufactured in order to achieve maximum profit because these are the bags that contribute the most to the amount of profit earned.

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Table No 1: Quantity of raw materials available in stock

Raw materials	Quantity available
Fabric	35653800(grams)
Handle(cotton rope)	483028(meters)
Stitching Yarn	10501400(meters)
zipper	54600(number)
Snap Button	218400(number)

Table No 2: Quantity of raw materials needed to produce each product

Product(GarmentBag)	Fabric	Handle(Cottonrope)	Yarn	Zipper	Snap Button
60 x 110	524	7.10	183	1	4
70 x 110	529	7.50	185	1	4
50 x 140	501	7.90	187	1	4
75 x 140	633	8.90	192	1	4
65 x 200	851	10.60	202	1	4
65 x 212	880	11.08	205	1	4

Table No 3: Average Cost and Selling Cost of each product

Product(GarmentBag)	Average Cost (Rs)	Selling Cost (Rs)	Profit
60 x 110	354.50	458	103.50
70 x 110	363.64	546	182.36
50 x 140	339.67	440	100.33
75 x 140	456.71	598	141.29
65 x 200	483.86	660	176.14
65 x 212	491.97	686	194.03

Output of MS-EXCEL Solver

Objective Cell (Max)					
	Cell	**Name**	**Original Value**	**Final Value**	
	C4	Max Z= Profit	0	10115461.61	
Variable Cells					
	Cell	**Name**	**Original Value**	**Final Value**	**Integer**
	C9	Values x1	0	0	Contin
	D9	Values x2	0	41009.11681	Contin
	E9	Values x3	0	0	Contin
	F9	Values x4	0	0	Contin
	G9	Values x5	0	0	Contin
	H9	Values x6	0	13590.88319	Contin

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RESEARCH ARTICLE

The GC MS Study of One Ayurvedic Formulation, Dadimashtaka Churnam

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ABSTRACT

The present study is to subject one Ayurvedic formulation Dadimashtaka churnam to GC MS analysis to find the types of molecules present therein. This medicine is prescribed for digestive disorders like malabsorption syndrome, irritable Bowel syndrome, diarrhoea, lack of appetite etc. The medicine was procured form standard Ayurvedic vendor at Chennai and processed as per protocol before GC MS analysis. The GC MS profile revealed the presence of molecules such as Propanal, 2-methyl-3-phenyl-, Thymol, 3-Cyclohexene-1-methanol, .alpha.,.alpha.,4-trimethyl-, acetate, Benzoic acid, 4-isopropyl-, ethyl ester, Disulfide, di-tert-dodecyl, 12,15-Octadecadienoic acid, methyl ester, 6-Octadecenoic acid, methyl ester, (Z)-, Oleic Acid, 9,12,15-Octadecatrienoic acid, methyl ester, (Z,Z,Z)-, 1H-Indene, 2,3,3a,4,7,7a-hexahydro-2,2,4,4,7,7-hexamethyl-, 1,15-Pentadecanedioic acid, Z-(13,14-Epoxy)tetradec-11-en-1-ol acetate, Piperine, Stigmasterol, .gamma.-Sitosterol etc. which could play a vital role in the cure of digestive disorders. The role of Dadimastakam in curing digestive disorders seems to get support from the various molecules present in it as shown by the GC MS analysis.

Keywords: Dadimastakam, GC MS, Ayurvredic, Propanal, 2-methyl-3-phenyl-, Thymol, Piperine, Stigmasterol, .gamma.-Sitosterol.

INTRODUCTION

Modern analytical tools such as GC MS, LCMS, HPTLC and some spectroscopic techniques have helped in the analysis of chemical constituents in practically any plant or plant products. Of late some reports on the GC MS studies of some alternative medical formulation have come up and this endeavour continues [1-21]. This knowledge could be of great help in understanding the mechanism of action of these forms of medicines which have not been documented earlier. In continuation of our work, the present study deals with the GC MS analysis of one Ayurvedic formulation Dadimashtaka churnam. This medicine is prescribed for digestive disorders like malabsorption syndrome, irritable bowel syndrome, diarrhoea, lack of appetite etc. This medicine is prepared the following ingredients: One part of Tawaksheeri (*Curcuma angustifolia*), 2 parts each of Twak (*Cinnamum zeylanicum*), Patra (*Cinnamomum tamala*), Ela (*Elettaria cardamomum*), Nagakesara (*Mesua ferrea*), Ajamoda (*Carum roxburghianum*), Dhanyaka (*Coriandrum sativum*), Ajaji or Swethajeeraka (*Cuminum cyminum*), Granthi or Pippalimoola, (*Piper longum* Root), Shunti (*Zingiber officinalis*), Maricha (*Piper nigrum*), Pippali (*Piper longum*), Dadima (*Punica granatum* Pericarp) and 12 parts of sugar. All the ingredients are separately powdered and mixed to get this formulation. The dosage of this medicineis 3 to 6 g with warm water twice a day or advised by the physician. The reference of this medicine is found in the Ayurvedic treatise Bhaishajyaratnavali. This is manufactured by Arya Vaidya Sala, Kottakkal, Nagarjuna among others.

MATERIALS AND METHODS

Dadimastaka churnam was obtained from standard Ayurvedic vendor at Chennai and was subjected to GC MS analysis by standard procedure.

Instrument

Gas chromatography (Agilent: GC: (G3440A) 7890A. MS MS: 7000 Triple Quad GCMS,) was equipped with Mass spectrometry detector.

Sample Preparation

100 micro lit sample Dissolved in 1 ml of suitable solvents. The solution stirred vigorously using vortex stirrer for 10 seconds. The clear extract was determined using gas-chromatography for analysis. The compounds are identified by GC-MS Library (NIST & WILEY).

RESULTS AND DISCUSSION

The GC MS profile of Dadimashtaka churnam is represented in Figure 1. Table1 indicates the retentions time, types of possible compound, their molecular formulae, molecular mass, percentage peak area and their medicinal roles of each compound as shown in the GC MS profile of Dadimashtaka churnam. The identification of metabolites was accomplished by comparison of retention time and fragmentation pattern with mass spectra in the NIST spectral library stored in the computer software (version 1.10 beta, Shimadzu) of the GC-MS along with the possible pharmaceutical roles of each bio molecule as per Dr. Duke's Phytochemical and ethnobotanical data base (National Agriculture Library, USA) and others as shown in Table 1 [22]. Some research towards the medicinal roles of Dadimastakam is quite encouraging. Singh and Pande, 2016 have evaluated the pharmacognostic aspect of Dadimashtaka [23]. Singh and Pande, 2017 have also reported a comparative quality standard analysis of

Dadimastakam [24]. Singh and Pande, 2019 have subjected Dadimastakam to HPTLC to estimate the presence of Ellagic acid in it [25]. Narang *et al,* 2019 have reported the positive role of Dadimastakam on malabsorption syndrome on school going children [26]. Narang and Herswani, 2018 have reviewed the clinical importance of Dadimashtakam [27]. In the present study the GC MS analysis indicated the presence of some important biomolecules such as Propanal, 2-methyl-3-phenyl-, Thymol, 3-Cyclohexene-1-methanol, .alpha.,.alpha.,4-trimethyl-, acetate, Benzoic acid, 4-isopropyl-, ethyl ester, Disulfide, di-tert-dodecyl, 12,15-Octadecadienoic acid, methyl ester, 6-Octadecenoic acid, methyl ester, (Z)-, Oleic Acid, 9,12,15-Octadecatrienoic acid, methyl ester, (Z,Z,Z)-, 1H-Indene, 2,3,3a,4,7,7a-hexahydro-2,2,4,4,7,7-hexamethyl-, 1,15-Pentadecanedioic acid, Z-(13,14-Epoxy)tetradec-11-en-1-ol acetate, Piperine, Stigmasterol, .gamma.-Sitosterol etc. which have far reaching medicinal roles auguring well with the medicine's capacity to cure digestive orders.

CONCLUSION

It is concluded that the presence of many medicinally important molecules in Dadimashtakam could assist it in curing digestive disorders as claimed by Ayurveda. It will be important to find the medicinal roles of those molecules for which no reports are available.

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Table1.Indicates the retentions time, types of possible compound, their molecular formulae, molecular mass, per cent peak area and their medicinal roles of each compound as shown in the GC MS profile of Dadimashtaka Churnam

Sl. No	Retention Time	Compound Name	Mol. Formula	Mol. Weight	% Peak Area	Possible medical Role
1	6.28	Propanal, 2-methyl-3-phenyl-	C10H12O	148.1	1.10	Catechol-O-methyl-Transferase Inhibitor, methyl Donar, Methyl Guanidine Inhibitor
2	7.05	Thymol	C10H14O	150.1	8.18	Thymol is reported to have hair growth potential.[27]Thymol derivatives have antioxidant, antibacterial and anti-inflammatory activities.[28-31]
3	7.74	3-Cyclohexene-1-methanol, .alpha.,.alpha.,4-trimethyl-, acetate	C12H20O2	196.1	3.00	5, alpha-reductase inhibitor, alpha-amylase inhibitor, alpha-glucosidase inhibitor, alpha-reductase inhibitor, HIF 1 alpha inhibitor, increase alpha-N-mannosidase activity, interleukin-1 alpha inhibitor, testosterone 5-alpha reductase inhibitor TNF-alpha inhibitor
4	7.95	Propanediamide, 2-ethyl-2-phenyl-	C11H14N2O2	206.1	0.65	Not known
5	8.35	Benzoic acid, 4-isopropyl-, ethyl ester	C12H16O2	192.1	1.05	Acidifier, Arachidonic acid inhibitor, Increases Aromatic Amino acid Decarboxylase activity
6	8.59	Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trimethyl-4-vinyl-	C15H24	204.2	1.50	Not known

7	9.39	Tricyclo[5.4.0.0(2,8)]undec-9-ene, 2,6,6,9-tetramethyl-, (1R,2S,7R,8R)-6	C15H24	204.2	0.77	Not known
8	9.57	1,3-Cyclohexadiene, 5-(1,5-dimethyl-4-hexenyl)-2-methyl-, [S-(R*,S*)]-	C15H24	204.2	0.65	Not known
9	9.73	Bicyclo[7.2.0]undec-4-ene, 4,11,11-trimethyl-8-methylene-	C15H24	204.2	1.39	Not known
10	9.88	Cyclohexene, 3-(1,5-dimethyl-4-hexenyl)-6-methylene-, [S-(R*,S*)]-	C15H24	204.2	0.79	Not known
11	11.28	Butan-2-one, 4-(3-hydroxy-2-methoxyphenyl)-	C11H14O3	194.1	0.45	Not known
12	12.98	Disulfide, di-tert-dodecyl	C24H50S2	402.3	0.38	Antidote, Coronary dilator, Diuretic, digestive, increases Super oxide dismutase activity
13	14.19	Naphthalene, decahydro-1,1-dimethyl-	C12H22	166.2	7.92	Not known
14	15.73	12,15-Octadecadienoic acid, methyl ester	C19H34O2	294.3	3.13	Catechol-O-methyl-Transferase Inhibitor, methyl Donar, Methyl Guanidine Inhibitor, Acidifier, acidulant, Arachidonic acid inhibitor, Increases aromatic amino acid decarboxylase activity, inhibits production of Uric acid
15	15.81	6-Octadecenoic acid, methyl ester, (Z)-	C19H36O2	296.3	10.71	Catechol-O-methyl-Transferase Inhibitor, methyl Donar, Methyl Guanidine Inhibitor, Acidifier, acidulant, Arachidonic acid inhibitor, Increases aromatic amino acid decarboxylase activity, inhibits production of Uric acid, Increases zinc bio-availability
16	16.06	Heptadecanoic acid, 16-methyl-, methyl ester	C19H38O2	298.3	0.45	Catechol-O-methyl-Transferase Inhibitor, methyl Donar, Methyl

						Guanidine Inhibitor, Acidifier, acidulant, Arachidonic acid inhibitor, Increase aromatic amino acid decarboxylase activity, inhibits production of Uric acid
17	16.18	Oleic Acid	C18H34O2	282.3	4.51	Acidifier, acidulant, Arachidonic acid inhibitor, Increases aromatic amino acid decarboxylase activity, inhibits production of Uric acid
18	16.97	9,12,15-Octadecatrienoic acid, methyl ester, (Z,Z,Z)-	C19H32O2	292.2	1.09	Acidifier, acidulant, Arachidonic acid inhibitor, Increases aromatic amino acid decarboxylase activity, inhibits production of Uric acid
19	17.31	1H-Indene, 2,3,3a,4,7,7a-hexahydro-2,2,4,4,7,7-hexamethyl-	C15H26	206.2	2.52	Anti-5-HT, Anti-HIV integrase, Antidote, Aryl-Hydrocarbon hydroxylase inhibitor, HIF- 1Alpha-Inhibitor, Increases Tyrosine hydroxylase activity, Suppress HMG-CoA reductase activity,11B-HSD-inhibitor, 17-Beta hydroxysteroid dehydrogenase inhibitor of7-HETE-inhibitor, 6-HT, 8-HETE,Hemagglutinator
20	17.47	1,15-Pentadecanedioic acid	C15H28O4	272.2	0.57	Acidifier, acidulant, Arachidonic acid inhibitor, Increases aromatic amino acid decarboxylase activity, inhibits production of Uric acid
21	17.70	4-Butylbenzoic acid, 1-adamantylmethyl ester	C22H30O2	326.2	8.50	Acidifier, acidulant, Arachidonic acid inhibitor, Increases aromatic amino acid decarboxylase activity, inhibits production of Uric acid
22	18.50	6-Octadecenoic acid	C18H34O2	282.3	1.26	Acidifier, acidulant, Arachidonic acid inhibitor, Increases aromatic amino acid decarboxylase activity, inhibits production of Uric acid

23	18.86	9-Octadecenoic acid, (E)-	C18H34O2	282.3	10.94	Acidifier, acidulant, Arachidonic acid inhibitor, Increases aromatic amino acid decarboxylase activity, inhibits production of Uric acid
24	19.15	Z-(13,14-Epoxy)tetradec-11-en-1-ol acetate	C16H28O3	268.2	0.42	Increase Zinc bio availability, oligosaccharide provider, decreases endothelial leukocyte adhesion, decreases endothelial platelet adhesion, endocrine tonic and energizer
25	19.40	Bis(2-ethylhexyl) phthalate	C24H38O4	390.3	3.25	Not known
26	19.56	1,3-Dioxolo[4,5-c]pyran, tetrahydro-, 7-(2-acetoxyethyl)-7-hydroxy-2,2-dimethyl-4-(3-methoxycarbonyl-2-methylallyl)-	C18H28O8	372.2	0.37	Not known
27	19.80	Trichloroacetic acid, 1-adamantylmethyl ester	C13H17Cl3O2	310	0.79	Acidifier, acidulant, Arachidonic acid inhibitor, Increases aromatic amino acid decarboxylase activity, inhibits production of Uric acid
28	19.90	7,10,13-Eicosatrienoic acid, methyl ester	C21H36O2	320.3	0.44	Catechol-O-methyl-Transferase Inhibitor, methyl Donar, Methyl Guanidine Inhibitor, Acidifier, acidulant, Arachidonic acid inhibitor, Increases aromatic amino acid decarboxylase activity, inhibits production of Uric acid
29	20.72	Silane, diphenyldecyloxy(2,2,3,4,4,4-hexafluorobutoxy)-	C26H34F6O2Si	520.2	0.54	Not known
30	21.03	Butyl 9,12-octadecadienoate	C22H40O2	336.3	0.41	Not known
31	21.33	Decanedioic acid, bis(2-ethylhexyl) ester	C26H50O4	426.4	1.40	Acidifier, acidulant, Arachidonic acid inhibitor, Increases aromatic amino acid decarboxylase activity, inhibits production of Uric acid

32	21.47	2,6,10,14,18-Pentamethyl-2,6,10,14,18-eicosapentaene	C25H42	342.3	0.36	Not known
33	21.69	Piperine	C17H19NO3	285.1	11.44	Radioprotective, immunomodulatory, antitumor, antidepressant, anticonvulsant, antinociceptive and antiarthritic, and helps in the absorption of selenium, Vitamin B, and beta carotene and other nutrients
34	22.10	2-(7-Hydroxymethyl-3,11-dimethyl-dodeca-2,6,10-trienyl)-[1,4]benzoquinone	C21H28O3	328.2	0.85	Not known
35	23.24	4a,7a-Epoxy-5H-cyclopenta[a]cyclopropa[f]cycloundecen-4(1H)-one, 2,7,10,11-tetrakis(acetyloxy)decahydro-8,9-dihydroxy-1,1,3,6,9-pentamethyl-	C28H40O12	568.3	0.41	Not known
36	23.60	1,3-Dimethoxy-5-(1-methyl-heptyl)-benzene	C16H26O2	250.2	0.54	Catechol-O-methyl-Transferase Inhibitor, methyl Donar, Methyl Guanidine Inhibitor
37	24.03	Stigmasterol	C29H48O	412.4	0.85	Precursor of progesterone, acts as intermediate in the biosynthesis of androgens, estrogens, anti-osteoarthritic, antihypercholesterolemic, cytotoxic, antitumor, hypoglycemic, antimutagenic, antioxidant, anti-inflammatory, analgesic[32]
38	24.38	.gamma.-Sitosterol	C29H50O	414.4	4.60	PPAR-gamma antagonist
39	24.77	Octanoic acid, 1a,2,5,5a,6,9,10,10a-octahydro-5,5a-dihydroxy-4-(hydroxymethyl)-1,1,7,9-tetramethyl-11-oxo-1H-2,8amethanocyclopenta[a]cyclopropa[e]cyclodece	C28H42O6	474.3	0.59	Not known

		n-6-yl ester, [1aR-(1a.alpha.,2.alpha.,5.beta.,5a.beta.,6.beta.,8a.alpha.,9.alpha.,10 a.alpha.)]-				
40	26.21	8,14-Seco-3,19-epoxyandrostane-8,14-dione, 17-acetoxy-3.beta.-methoxy-4,4-dimethyl-	C24H36O6	420.3	1.26	17 beta hydroxysteroid dehydrogenase inhibitor, Antiamyloid beta, Anto TGF beta, Beta receptor agonist, Beta-adrenergic receptor blocker, beta blocker, beta galactosidase inhibitor, beta glucuronidase inhibitor, ER beta binder

Qualitative Compound Report

Data File	200520013.D	**Sample Name**	Dadimashtaka Churnam	
Sample Type		**Position**		25
Acq Method	GC Screening Method.M	**Acquired Time**	22-05-2020 AM 04:38:21	
Comment				

User Chromatogram

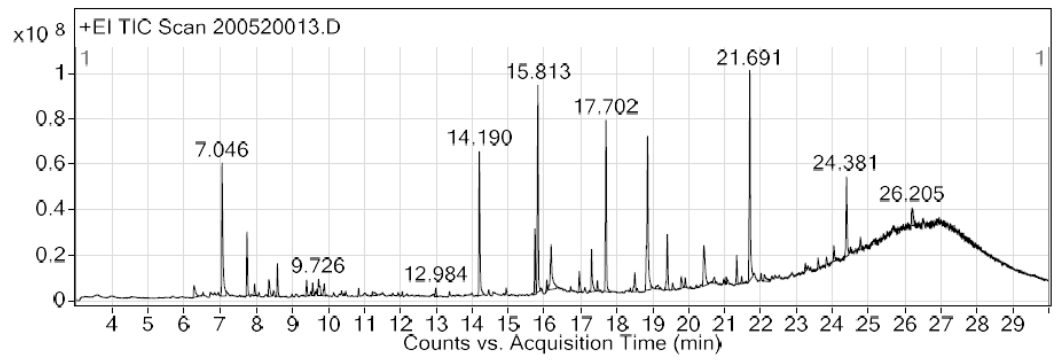

Fig. 1. Depicts the GC MS profile of Dadimastakam.

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RESEARCH ARTICLE

Feedback Icane for Echo-Friendly and Hospital Convenient Incinerator

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ABSTRACT

The increase in healthcare sector has lead to increase in generation of enormous amount medical waste. Inefficient handling of Biomedical Waste (BMW) in a hospital environment poses a severe threat to workers, patients, waste handlers and the general human community due to possibility of transmission of pathogens. So, a convenient and safe biomedical waste management system is needed to avoid these kinds of major issues. In this regards we proposed an Eco-friendly incinerator design for suitable usage with low cost. The process involves burning of the waste at heavy elevated temperatures (up to 8000°C) under controlled operating conditions in a chamber known as incinerator. The end products generated are carbon dioxide, carbon monoxide and nitrogen oxides with ash as residual materials. This is done by transporting wastes from hospital to a common treatment plant, but it has disadvantages which are like spilling while transportation which leads pathogens to affect the workers and peoples nearby and while incinerating it emits enormous amount of harmful gases into environment which is a massive air pollutant. To prevent these kinds of risk of transportation and environmental pollutions, we have novel idea to develop a hospital convenient incinerator attached with catalytic converter which does not cause any harm to the hospital environment and a pollution free incineration technique which is environment friendly.

Keywords: Incinerator, Catalytic converter, Heap, Chamber, Medical Waste Management

INTRODUCTION

As there is a tremendous increase in the healthcare domain it leads to the generation of an enormous amount of biomedical wastes which is not disposed of properly and around 75% of biomedical waste is dumped in landfills. Inefficient handling of Biomedical wastes in a hospital environment cause severe issues to workers, patients, waste handlers and the general people due to possibility of transmission of pathogens [1]. Therefore, we need a safe and convenient biomedical waste management system is needed to avoid these kinds of hazard threats. Commonly, incineration is one of the most widely used methods for disposal of biomedical wastes. This process involves burning of the waste at very high level temperatures (up to 8000) under controlled operating conditions in a burning chamber known as incinerator which burns the waste and emits an enormous amount of greenhouse gases. So to avoid these kinds of environmental pollution and hazardous threat while transportation we have an idea to develop a hospital convenient incinerator attached with a catalytic converter which does not cause any harm to the hospital environment and a pollution-free incineration technique which is environment friendly [2-4]. This uses a catalytic converter which converts the greenhouse gases to non-harmful gases in lower cost and completely safe to the hospital environment while using it in the hospital.

Incineration Technology

Most of the hazardous waste obtained by burning of various sources consists of carbon, hydrogen, oxygen with halogens like sulphur, nitrogen, heavy metals and other toxic substances in trace quantities. The hazardous waste so obtained is detoxified by subjecting to the incineration process which is gaining popularity as a disposal technology in the field of hazardous waste management. Incineration may be defined as the thermal destruction of the waste at elevated temperature say 8000 under controlled operational condition. The products of combustion are carbondioxide, water, and ash as a residue [5, 6]. The unit in which the process takes place is termed as Incinerator. Properly controlled incineration is an effective means of reducing waste volume. It ensures cleaner and more complete combustion of waste and lends itself well to waste disposal in areas where population density is relatively high and availability of sites for landfill is low [7-8]. Potential pollutants can be contained within the resulting residue which, if disposed of carefully, reduces the risk of contamination of local groundwater. Landfill will always be required for the residue, which typically amounts to about one-third of the initial mass of waste [8]. There are however, a number of technical, social and environmental problems associated with incineration. These arise from the potential pollutants contained in the emissions and residual solids remaining after from the combustion process. With the basic knowledge in incineration technology and waste management, the project was carried out as an interdisciplinary work with civil department and further process was carried out.

Overall Methodology

The Incineration process is an effective means of reducing the biomedical waste volume particularly for high population density areas and consequently with less availability of land area for landfill sites are as shown in figure 1. It is a clean and efficient waste disposal technology as it reduces the amount of residue to be dumped in the landfill site by about 70-75%. The incineration process is used in various industries and construction of the same is mentioned. The primary assumptions and calculations for a biomedical waste incinerator are valuated from literature survey. With the collected data design of the incinerator is designed by various segments as primary chamber, secondary chamber, blower, catalytic converter and activated carbon filter. The various segments were designed for burning an amount of 65kg biomedical waste hourly and can be increased accordingly to their hospital needs. The catalytic converter is an open-channel metallic honeycomb substrates made of platinum, rhodium and palladium that provides support to the catalysis's. It is the most popular catalyst material used for the substrate. Which efficiently filter converts the harmful gases. The activated Carbon filter works by adsorption, in which pollutants in the fluid to be treated are trapped inside the pore structure of a carbon substrate which is used to filter out the sulphur compounds. CFD for the designed model has been performed using COMSOL multi-physics to verify our incinerator design. The figure .1 given below describes the overall methodology.

MATERIALS AND METHODS

Incinerator Designing

The following steps were used to design the incinerator. Each step of the design procedure has been discussed in detail including the assumptions involved in the design process. The overall schematic structure of the proposed project design is shown in figure 2.

Design of Primary Chamber

For designing of Primary chamber of Multiple Chamber Incinerator under controlled air conditions initially volume of primary chamber is to be determined so as 50 kg of 9 waste is dumped and the volume of heap is considered. Nichrome coil is used for ignition and it could go up to 8000 C. Appropriate heap volume (50kg)=3m^3 Height for chamber 1.5m Area of chamber = 3/1.5=2m^2 Appropriate length and radius as 1:1 So that, L/R=1/1 L=R Dimensions for the primary burning chamber=L*R*R Area=L*R*R L=1.5m R=1.5m

Assumptions in the Design

The Temperature of the waste and air in burning chamber is assumed as 15.5°C and may vary according to the waste condition. The air blown by our blower consists of 23 % oxygen and 77 % Nitrogen by percentage. Whereas the air contains 0.0132 Kg H2O/Kg dry air at 60% relative humidity and 26.7°C dry temperatures. Considering this parameter the air we blow through the blower into the burning chamber is ideal for burning.

Design of the Secondary Chamber

The active chamber volume required to achieve one second retention is 0.8m3 ('dead' areas with little or no flow should not be included in the retention volume). It should be noted that in sizing the secondary chamber to meet the one second retention time required (65kg/Hr), the length of chamber should be calculated from the flame front to the location of the temperature sensing device.

Design of the Blower

The blower fan has a radius of 30cm and speed of 500rpm motor speed and a unidirectional value connected in front to take air inlet to create the potential flow speed to pass through catalytic converter.

Catalytic Converter

The catalytic converter is made of metallic honey comb structure and is coated with platinum, palladium and rhodium which act as the catalyst to faster the reaction as shown in figure 3. These three were the popular catalyst material used in catalytic converters. These materials exhibit characteristics like large surface area, less thermal expansion and high tensile strength. Metallic substrates are made of metal, silica, iron, chromium, and aluminium alloys. They have higher surface areas and low-pressure drop but are more expensive. These substrates are coated with platinum, palladium and rhodium. The catalyst performs by two step process called as reduction and oxidation. The catalysts could efficiently perform more than 800°C. A catalytic converter could perform maximum 5000 hours. The two major reactions take place in catalytic conversion. They are reduction reaction and oxidation reaction. The platinum is the most active catalyst which is used for both oxidation and reduction reaction. For reduction reaction platinum and rhodium were used as catalyst. For oxidation reaction platinum and palladium were used as catalyst.

Activated Carbon Filters

The activated carbon filter works by the principle of adsorption, in which the hazardous compounds are trapped in its porous structure. The ACF is made up of carbon granules which is a highly porous material. One gram of ACF has a surface area of 3,000m^2 and can filter up to 300m^3 of hazardous gases. The incinerator is charged cold. Because these units generally are small, they are usually loaded manually. The waste is loaded into the ignition chamber, which is filled to the capacity recommended by the manufacturer. Typically, they will recommend filling the

incinerator completely, but not overstuffing the chamber. Overstuffing can result in blockage of the air port to the combustion chamber and in premature ignition of the waste and poor performance during the start up period. Overstuffing can result in blockage of the ignition burner port and damage to the burner. When the charging is completed, the charge door seal gasket is visually checked for irregularities. The door is then slowly closed and locked. The charge door seal gasket should then be inspected for any gaps that would allow air infiltration into the primary chamber. Once operation is initiated, no further charges will be made until the next operating cycle is initiated, i.e., after cool down and ash removal. Prior to ignition of the waste, the secondary combustion chamber is preheated to a predetermined temperature by igniting the secondary burner. A minimum secondary chamber temperature of 980°C (1800°F) is recommended prior to ignition of the waste. The manufacturer should be consulted regarding proper preheat procedures; improper preheat can result in refractory damage. After the secondary chamber is preheated, the secondary combustion air blower is turned on to provide excess air for mixing with the combustion gases from the primary chamber. The primary chamber combustion air blower is activated and the primary burner is ignited to initiate waste combustion. When the primary chamber reaches a preset temperature and the waste combustion is self-sustaining, the primary burner is shutdown. The primary combustion air and secondary combustion air are adjusted 'to maintain the desired primary and secondary chamber temperatures. During operation period, the primary burner is reignited if the ignition chamber temperature falls below a preset temperature. Similarly, the secondary burner is reduced to its lowest firing level if the secondary chamber rises above a preset high temperature setting. Again, control of the burners, like the combustion air, is typically automated. A barometric damper on the stack is used to maintain draft. The incinerator chambers should both be maintained under negative draft.

RESULTS AND DISCUSSIONS

The first three steps that are mentioned in overall methodology are a combination of parameters that involves fluent properties. So results are simulated using Multi-physics COMSOL software. The screenshots are taken and discussions are made. The below CFD image for blower in figure (4) describes the working model of our incinerator.
The second step/design that is involved in incineration process is designing of primary and secondary chambers as shown in figure 5. This is considered to be very important dimension as it involves the processing of total volume of biomedical waste that is feed into the design. As per metrics it is dimensionally designed in the simulation software. This CFD analysis shows that our chamber design is enough to incinerate the waste using the air from blower and heat from the coil.

The parameters can be considered for the above simulated model shown in figure. Throughput is to be 50 kg/h of Waste. The auxiliary fuel is natural gas; the waste has been ignited; and the secondary burner is modulated. Design requirements are summarized as follows: Secondary chamber temperature: 1100°C Flue gas residence time at 1000°C: 1 second Residual oxygen in flue gas: 6% minimum. The next simulation that is carried out is catalytic converter. Modelling of heterogeneous catalysis traditionally attracts great interest from the chemical engineering community, due to the many industrial processes that utilize this type of catalysis. Here, we discuss the procedure of starting with detailed micro-geometries and then proceeding with approximations through homogenization which is shown in figure 6. By following the procedure of homogenization and approximation, from the microscopic particle level to the macroscopic reactor level, we can design the catalyst in detail and study the influence of this design on the total reactor performance.

CONCLUSION

In this research work, a concept was proposed for using CFD simulation results in a supervisory control system for bio-medical waste incinerator. It is highlighted that an environment eco-friendly incineration system is highly needed for such inadequately designed furnace systems. To provide the data for the feed forward control system, distributed information from CFD simulations after proper processing could be very useful for building up part of

the control database. Presently, the combustion models for the incineration system are under further development and at the same time, different operating and feed material scenarios are being simulated with help of software. It's compared with temperature measurements to validate the results. The various distributions provide the operator with different valuable diagnostic information, which can be used to optimise the plant operation. The complexity of the interaction between various medical waste and material processing facilities becomes apparent. If this complex system is to be optimised, the control on the individual plant level should be optimal. Due to the complexity of the various material streams it is often very difficult to optimally control the individual reactors.

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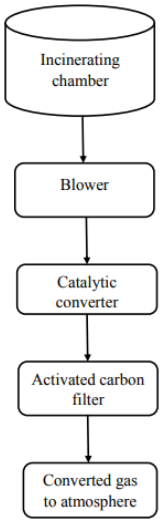

Figure 1: Overall Methodology

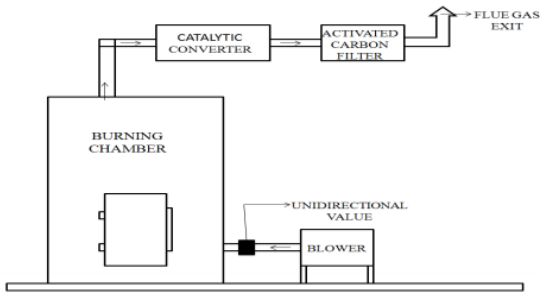

Figure 2: Incineration Design

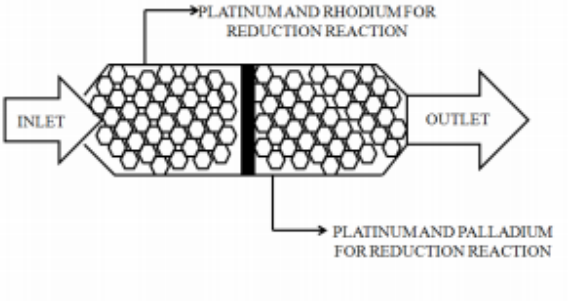

Figure 3: Catalytic Converter

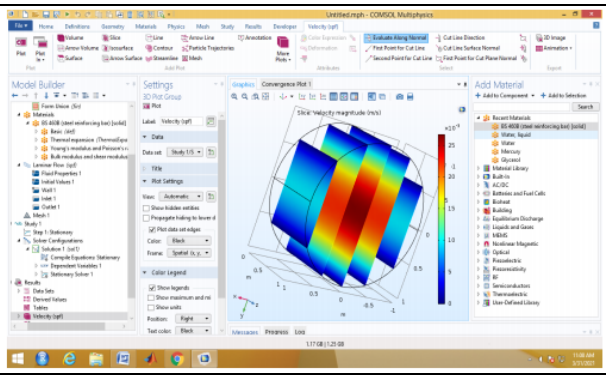

Figure 4: Blower Fluent Model

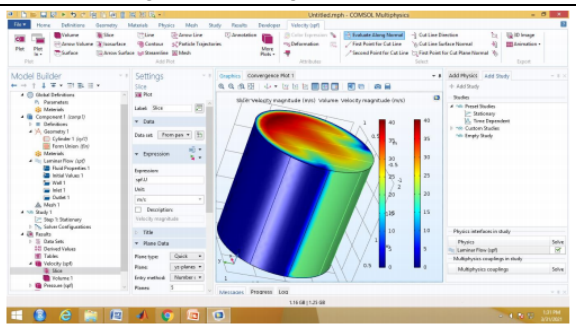

Figure 5: Chamber Design

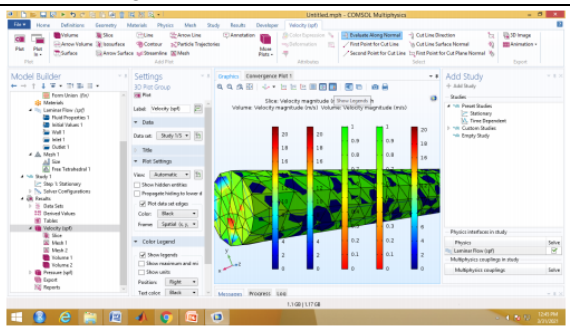

Figure 6: Catalytic Converter Design

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RESEARCH ARTICLE

A Study to Assess the Effectiveness of Video Assisted Teaching Module on Knowledge, Practice and Attitude Regarding Menstrual Hygiene among Girls at Selected College, Karaikal.

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ABSTRACT

Menstruation is generally considered as unclean in the Indian society. Isolation of the menstruating girls and restrictions being imposed on them in the family, have reinforced a negative attitude towards this phenomenon. The objectives of the study are adolescent girls often do not receive accurate information about menstrual health because of culturally specific practices that lead to incorrect and unhealthy behaviour. Learning and knowledge about hygiene during menstruation is a vital aspect of health education for adolescent girls. 1**.** To assess the pretest level of knowledge, practice and attitude regarding menstrual hygiene among girls in selected college. 2. To evaluate the effectiveness of Video Assisted Teaching Programme on knowledge, practice and attitude regarding menstrual hygiene among girls in a selected college. 3. To find out the association between the pre-test knowledge, practice and attitude scores with selected demographic variables. Quantitative approach and Pre experimental with one group pre-test post test research design was used in this study. Purposive Sampling Technique was used to select 500 girls studying at Avaiyar Arts and Science college for women, Karaikal as study participants. Pretest was conducted using the Structured Questionnaire to assess the knowledge, practice and attitude regarding Menstrual hygiene. On the same day of pre test, Video assisted teaching was delivered to the students on knowledge, practice and attitude regarding Menstruation and Menstrual hygiene. Post test was conducted on the 7th day by using the same structured questionnaire. The collected data was analyzed using descriptive statistics and Inferential Statistics. In study group on effectiveness of video teaching programme on knowledge regarding menstrual hygiene among girls in pre test mean was 14.83

and standard deviation was 2.663 and standard error mean was 0.119. In post test mean was 27.34, standard deviation was 1.799 and standard error mean was 0.080, mean difference was 499, t- value was 98.210 and obtained p-value was 0.000*. Effectiveness of video teaching programme on attitude regarding menstrual hygiene among girls in pre test mean was 25.91 and standard deviation was 4.710 and standard error mean was 0.211. In post test, mean was 34.73, standard deviation was 3.971 and standard error mean was 0.178, mean difference was 499, obtained t-value was 53.099 and p-value was 0.000*. Effectiveness of video teaching programme on practice regarding menstrual hygiene among girls in pre test mean was 17.84 and standard deviation was 2.220 and standard error mean was 0.099. In post test, mean was 19.78, standard deviation was 0.481 and standard error mean was 0.021, mean difference was 499, obtained t-value was -22.639 and p-value was 0.000*. Hence effectiveness of video assisted teaching programme was effective.

Keywords: Knowledge, Menstrual hygiene.

INTRODUCTION

Reproductive health includes sexual health, a condition defined by the WHO as freedom from sexual diseases or disorders and a quality to enjoy and sexual behavior without fear, shame, or guilt. Thus reproductive health is important constituent of general health and central feature of overall human development. Adolescence in girls has been considered as an important period which signifies the change from girlhood to women hood and is termed as an important landmark of female puberty. Menarche is the first menstrual period occurs during the period of adolescence and it is a physiological and developmental phenomenon significant in the life of a female. It occurs between the age of 10 to 16 years whereas in India, the average age being about 12 years. The average age at menarche show many socio economic, environmental, nutritional and geographical variations in the societies. It is an important aspect of the complex process of growing up and further it calls for specialized attentions because of the problems that are associated with it. During this period of growth, the maturing girls first experience menstruation with its related problems which are marked by feeling of anxiety and eagerness to know about this natural process. It is also been commonly observed that every adolescents experience one or other types of menstrual problems in her lifetime. Menstrual hygiene deals with the special health care need and requirements of women during monthly menstruation or menstrual cycle.

Menstruation is a natural, unique phenomenon for adolescent girls who experience shedding of blood for 1-7days every month from the age of maturity until menopause [3]. Menstruation is generally considered as unclean in the Indian society. Isolation of the menstruating girls and restrictions being imposed on them in the family, have reinforced a negative attitude towards this phenomenon. Adolescent girls often do not receive accurate information about menstrual health because of culturally specific practices that lead to incorrect and unhealthy behavior [2]. Though it is a natural process, is linked with several myths and practices which sometimes affects the health of the adolescents. Several studies have reported that some restrictions in daily activities such as, not being allowed to take bath, comb hair, change clothes, enter holy places, etc.,. Apart from these, dietary restrictions like taboo on consumption of certain food items like rice, curd, milk, lassi, potato, onion, sugarcane etc, during the menstrual period. All these leads to many serious health problems [4]. Cross sectional study conducted on menstrual hygiene management among five schools of adolescents girls in India 2020. Self administered structured questionnaire given to adolescent girls. Majority of the girls are using sanitary pads as absorbent during menstrual, 42.7% of the girls said they have been restricted from praying when seeing their menses and 49.5% of the girls said they feel their school is uncomfortable to keep hygiene during menstruation. The findings led to that girls have deficient knowledge and inadequate practice regarding menstruation and its management [5]. Learning and knowledge about hygiene during menstruation is a vital aspect of health education for adolescent girls. Adolescent girls constitute a vulnerable group

not only with respect to their social status but also in relation to reproductive health. Primarily poor personal hygiene and unsafe sanitary conditions result in gynaecological problems.

Statement of the Problem

A Study to Assess the Effectiveness of Video Assisted Teaching Module on Knowledge, Practice and Attitude Regarding Menstrual Hygiene among Girls at Selected College, Karaikal.

Aim / Objectives of the Research Study

To assess the pretest level of knowledge, Attitude and Practice regarding menstrual hygiene among girls in selected college.

To evaluate the effectiveness of Video Assisted Teaching Programme on knowledge, attitude and Practice regarding menstrual hygiene among girls in a selected college.

To find out the association between the pre-test knowledge, Attitude and Practice scores with selected demographic variables.

Hypothesis

H_1-There will be significant difference in level of knowledge, Attitude and Practice regarding menstrual hygiene among girls in a selected college.

H_2 -There will be Significant association between pretest scores of knowledge, attitude and Practice regarding menstrual hygiene among girls with selected demographic variables.

METHODOLOGY

Quantitative approach and Pre experimental with one group pre-test post test research design was used in this study. The study was conducted in Avaiyar Arts and Science College for women, Karaikal. The population for the present study was students studying in selected college, karaikal. The sample for the study was college girls studying in final year in Avaiyar Arts and Science College for women, Karaikal. The sample size was 500 girls studying at Avaiyar Arts and Science college for women, Karaikal. The tool consists of following sections: Section – A: Personal data consists of 13 items which includes Age, Name of the Course, Name of the year, educational status of the father, educational status of the mother, occupational status of the father, occupational status of the mother, family income per month, religion, residence, type of family, number of siblings, source of information regarding menstruation. Section-B: Health related variables consists of 8 items which includes Age of menarche, Frequency of changing napkin per day, perception of pain during menstruation, Nature of practice during menstruation, the method of disposal of material used to collect Menstrual flow, source of water supply utilized for cleanliness at Menstruation, way of cleaning perineum, Methods of disposal.

Section-C: A structured knowledge questionnaire consisting of 30 items on knowledge, regarding Menstruation and Menstrual Hygiene. Section –D: Structured Attitude four point Likert Scale regarding Menstruation and Menstrual Hygiene - 10items. Section –E: Structured practice check list regarding Menstruation and Menstrual Hygiene - 10 items. Prior permission will be obtained from the concern authority and obtained informed consent from the students personally. Pretest was conducted using the Structured Questionnaire to assess the knowledge, attitude and Practice regarding Menstrual hygiene for the duration of 30 minutes. For each session 10 – 15 sample were assembled in the classroom and pretest was conducted. On the same day of pretest, Video assisted teaching was delivered to the students on knowledge, Attitude and Practice regarding Menstruation and Menstrual hygiene. Post test was conducted on the 7th day to assess the knowledge, attitude and practice of girls regarding menstrual hygiene by using the same structured questionnaire. The collected data was planned to be organized, tabulated and analyzed based on the objectives of the study by using descriptive statistics and Inferential Statistics.

RESULTS AND DISCUSSIONS

With regard to age sixty six percentage (66%)of Girls where in the age group of 17yrs ,thirty one percentage (31%) of Girls in the age group of 18 years ,three percentage (3%) of Girls in the age group of 19 years. Thirty nine percentage (39%)of girls where studying Bachelor of science, thirty four percentage (34%)of girls where studying other courses and twenty seven percentage(27%) of girls where studying bachelor of science. 32.4% of Girls were studying first year ,33.8% of girls were studying second year,33.8% of girls were studying third year. 68 (13.6%) Fathers were illiterate, 147(29.4%) Fathers had primary school, 157 (31.40%) Fathers had high school, 70 (14%) Fathers had higher secondary, 58 (11.60%) were graduate. 95(19%) Mother were illiterate, 163 (32%) Mothers completed primary education, 220 (44%) mothers completed higher education, 11 (2.2) mothers completed higher secondary education and 11 (2.2%) mothers completed Graduation. 249 (49.8%) Girls Fathers were Employed, 53 (10.6%) of Girls fathers were un-employed, 198(39.6) of Girls fathers were self –Employed. 433 (86.6%) of Girls mothers were Housewife, 42(8.4%) of Girls mothers were Private Employee, 25 (5.0%) of Girls mothers were Government –Employee. Regarding the family income, majority 182(36.4) of girls family income were 5000, 144(28.8%)of girls family income were 5001 -7500, 105(21%)of girls family income were 7,501-10,000, and 63 (12.6%) of girls family income were more than 10,000. 319 (63.8%) of Girls were Hindu Religion, 107(21.4%) of Girls were Christian Religion and 74(14.8%) of Girls were Muslim Religion. 203(40.6%) of Girls were From Urban area, 297(59.4%) of Girls were From Rural area. 444(89.3%) of Girls were from Nuclear family, 56(10.7) of Girls were from Joint family. 49.2% of Girls having one siblings, 29% of Girls having two siblings, 22% of Girls having three and above siblings .

Girls were obtained information from mother were 341(68.2%), from relatives were 46 (9.2%), from Friends were 84 (16.8%), from Teacher were 21 (4.2%), and from others were 8 (1.6%). 19.8% of Girls attained menarche at the age of less than 12 years, 59.8% of girls attained menarche at the age of 12-14 years 20.4% percentage of girls attained at the age of more than 14 years. 53.2% of Girls were changing their napkins twice a day, 46.8% of Girls were changing their napkins thrice and above a day and none of them in once a day category. 4% of girls had pain perception during mensuration,81.2% of Girls had pain perception sometimes during menstruation ,15% of girls had pain perception always during the menstruation. 79.8% of Girls were using sanitary Napkins during menstruation , 11.8% of Girls were using cloth during menstruation 8.4% of Girls were using other methods. 49.2% of Girls were dispose their used material by Disposable method ,42.6% girls were dispose their used material by Burial method,8.2% of Girls were Dispose their used material by wash and reuse method. Regarding source of water supply utilized for cleanliness during menstruation were (6.8%) Girls were using well water, (66.8%) Girls were using Municipal water, (26.4%)Girls were using Bore water. 48.4% of Girls used to wash their perineum by Front to back ,38.4% Girls were used to wash their perineum by mixed method, 13.2% of Girls were used to wash their perineum by back to front. Regarding Methods of Disposal using Directly burn method Girls were (22%), girls were using throw outside method (31.6%), Girls were using Dumped method (46.4%).

Fig 1: During Pre-test 306(61,25%)of the girls had inadequate level of knowledge, 194(38.8%) of the girls had moderate level of knowledge. whereas during the post test 106 (21.2%) Girls had moderate level of knowledge, 394(78.8%) of girls had adequate level of knowledge, none of the girls had Inadequate level of knowledge.

Fig 2: In pre-test 386 (77.2%) of girls had poor attitude level, 102 (20.4%) of girls had Good attitude level , 12(2.4)of girls had had Excellent attitude level . whereas during the post test 10(2%) of girls had poor attitude level 160(32%)of girls h had Good attitude, 330(66%)of girls had Excellent Attitude level.

Fig 3: In pre-test 420 (84%) of girls had poor practice level, 70 (14%) of girls had good practice level, 10(2%) of girls had excellent practice level. whereas during the post-test 0% of the girls had poor practice level, 50 (10%) of girls had good practice level, 450 (90%) of girls had excellent practice level.

Fig 4: In study group the pre –test level of knowledge mean was 14.83, standard deviation was 2.663, and mean percentage was 35%. The post test level of knowledge mean was 27.34, standard deviation was 1.799 and mean percentage was 65%.it reveals that knowledge level is increased after video assisted teaching intervention on menstrual hygiene.

Fig 5: In study group the pre test level of attitude mean was 25.91 and standard deviation was 4.710, mean percentage was 43%.whereas the post test level of attitude mean was 34.73 and standard deviation was 3.971 and mean percentage was 57%.it reveals that attitude score on menstrual hygiene was increased after the video assisted teaching intervention.

Fig 6: In study group the pre –test level of practice mean was 17.84 , standard deviation was 2.220, and mean percentage was 47%. The post test level of practice mean was 19.78, standard deviation was 0.481 and mean percentage was 53%.it reveals that practice level is increased after video assisted teaching intervention on menstrual hygiene .

In study group on effectiveness of video teaching programme on knowledge regarding menstrual hygiene among girls in pre test mean was 14.83 and standard deviation was 2.663 and standard error mean was 0.119. In post test mean was 27.34, standard deviation was 1.799 and standard error mean was 0.080, mean difference was 499, t- value was 98.210 and obtained p-value was 0.000*. Effectiveness of video teaching programme on attitude regarding menstrual hygiene among girls in pre test mean was 25.91 and standard deviation was 4.710 and standard error mean was 0.211. In post test, mean was 34.73, standard deviation was 3.971 and standard error mean was 0.178, mean difference was 499, obtained t-value was 53.099 and p-value was 0.000*. Effectiveness of video teaching programme on practice regarding menstrual hygiene among girls in pre test mean was 17.84 and standard deviation was 2.220 and standard error mean was 0.099. In post test, mean was 19.78, standard deviation was 0.481 and standard error mean was 0.021, mean difference was 499, obtained t-value was -22.639 and p-value was 0.000*. There is a significant association between pre test knowledge and source of information among Girls .There is a significant association between pre test attitude and educational status of the father, occupational status of the mother. There is a significant association between pre test attitude and age of menarche, nature of practice during menstruation, method of disposal. There is a significant association between pre test Practice and family income, year of the course and Residence .There is a significant association between pre test attitude and age of menarche, nature of practice during menstruation, perception of pain during menstruation.

RECOMMENDATIONS

A similar study can be conducted as the comparative study to assess the level of knowledge, attitude and practice among urban and rural girls. A similar study can be conducted as the comparative study to assess the level of knowledge, attitude and practice among women.

CONCLUSION

The awareness programme regarding menstrual hygiene helps to improve the knowledge, attitude and practice level of girls. Proper hygiene prevents reproductive tract infections and improves reproductive health of the women.

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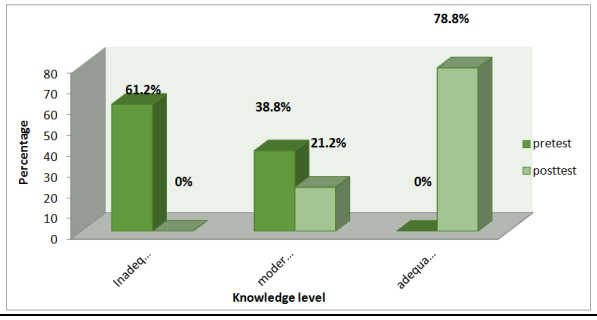

Fig 1:Comparison of pretest and posttest knowledge regarding menstrual hygiene among Girls

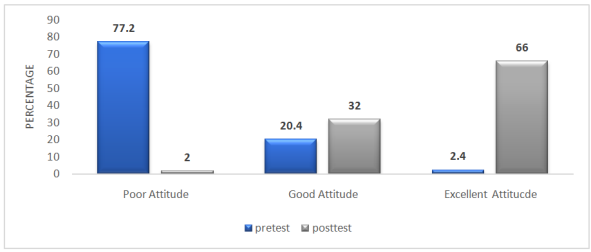

Fig 2: Comparison of pretest and posttest level of attitude regarding menstrual Hygiene among Girls

Fig 3: Comparison of pretest and posttest level of Practice regarding menstrual Hygiene among Girls

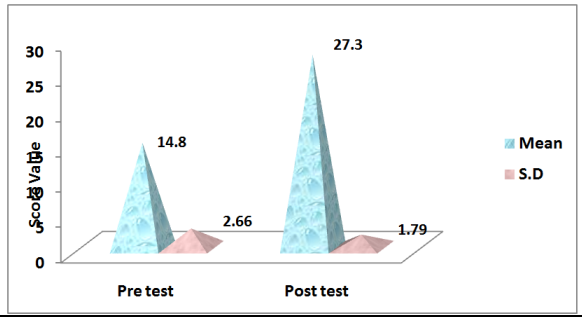

Fig 4: Comparison of mean and standard deviation of pretest and posttest level of knowledge score regarding Menstrual Hygiene among girls.

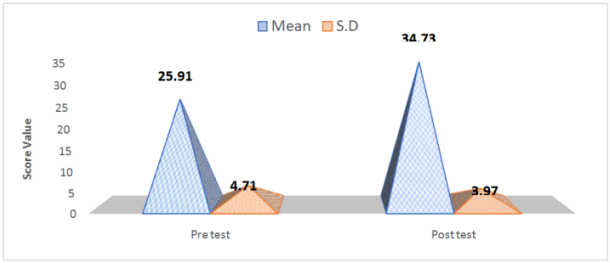

Fig 5: Comparison of mean and standard deviation of pretest and posttest level of attitude score regarding Menstrual Hygiene among girls.

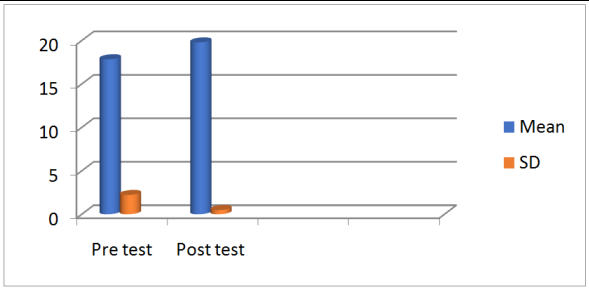

Fig 6: Comparison of mean and standard deviation of pretest and posttest level of attitude score regarding Menstrual Hygiene among girls.

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REVIEW ARTICLE

A Systematic Review on Diabetes Mellitus

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ABSTRACT

Diabetes mellitus is one of the most common non-communicable diseases in the world. The chronic metabolic disorder diabetes mellitus is a fast-growing global problem with huge social, health, and economic consequences. It is estimated that in 2010 there were globally 285 million people (approximately 6.4% of the adult population) suffering from this disease. This number is estimated to increase to 430 million in the absence of better control or cure. An ageing population and obesity are two main reasons for the increase. Furthermore, it has been shown that almost 50% of the putative diabetics are not diagnosed until 10 years after onset of the disease, hence the real prevalence of global diabetes must be astronomically high. The chronic disease is a dangerous one and prevalent condition that is caused by a complex interplay between genes and the environment. Other risk factors such as obesity and sedentary lifestyle also play a role in the development of diabetes. The present review aims to focuses on epidemiology, etiology, pathophysiology, diagnosis, and treatment of Diabetes Mellitus.

Keywords: Diabetes mellitus, diagnosis, cause and treatment.

INTRODUCTION

Diabetes mellitus (DM) is a metabolic condition characterized by elevated blood glucose levels as a result of impaired insulin production and action [1]. Diabetes mellitus is a chronic disorder of carbohydrates, fats, and protein metabolism. It is characterized by a defective or insufficient insulin secretory response that results in impaired carbohydrate (glucose) utilization [2].Insulin and glucagon hormones are both released by the pancreas and regulate blood sugar levels. Glucagon is secreted by the alpha (α) cells, and Insulin produced by the beta cells (ß) present in the Islets of Langerhan's[3]. Through glycogenesis, insulin lowers the level of blood glucose in the bloodstream and delivers glucose to the muscles, liver, and adipose tissue [4]. The usage of glucose by neural tissue and erythrocytes

is not dependent on insulin, but alpha (α) cells play an essential role in managing blood glucose by creating glucagon, which raises the blood glucose level by speeding up the breakdown of glycogen. Based on the above information, the present review aims to focuses on epidemiology, etiology, pathophysiology, diagnosis and treatment of Diabetes Mellitus.

Epidemiology

Global Scenario

Diabetes mellitus is a leading cause of death in the globe, and its incidence is increasing at an alarming rate. In 2012 and 2013, almost 1.5 million people died as a result of diabetes, with the number reaching 5.1 million in 2014 [5]. Africa has the highest proportion of diabetes-related mortality (76 45%), followed by South East Asia (55 %) and the Middle East (45%) and North Africa (50%). Diabetes expenditures in North America and the Caribbean were the highest (263 billion USD), followed by Europe (147 billion USD) and the Western Pacific (88 billion USD), according to the World Health Organization [6].

Indian scenario

Diabetes currently affects more than 62 million Indians, accounting for more than 7.2 % of the adult population [7]. According to the National Family Health Survey-4, the prevalence of diabetes among young and middle-aged adults is 6.7 %, and the prevalence of prediabetes is 5.6% [8]. The average age at which a disease first manifests itself is 42.5 years. India's southern states had the highest number of diabetes cases, with 13.5 % in Chennai, 16.6 % in Hyderabad, and 12.4 % in Bangalore, followed by eastern India, with 11.7 % in Kolkata, and western India with 12.4 %in Mumbai. 9.3 % in Mumbai, Northern India - 6.1 %in Kashmir Valley, and 11.6 %in New Delhi. Those living in northern India are less impacted (Chandigarh has 0.12 million diabetic cases, while Jharkhand has 0.96 million diabetic cases) [9].Migration is responsible for the disparity in diabetes incidence between different geographical regions. The populations of North India are migrants (non-indigenous), whereas the populations of South India are hosts (indigenous) [10]. Similarly, indigenous people from New Zealand and Australia were shown to have higher rates of diabetes than non-indigenous people. According to the most recent estimates, Sikkim state (13.67 %) has the highest rate of diabetes suspected, followed by Karnataka (9.36 %), Punjab (9.36 %), Gujarat (9.10 %), and Andhra Pradesh (7.42 %).

Etiology

Juvenile-onset Diabetes Mellitus

Juvenile-onset (insulin-dependent) type is caused by an autoimmune reaction. Viruses such as coxsackie [11], mumps, rubella, and other viruses have all been proven to cause morphologic abnormalities in the islet-cell structure. It was postulated that genetic characteristic renders an individual's pancreas more susceptible to one of the viruses listed above [12].

Type 1 Diabetes mellitus: Type 1 diabetes is caused by the immune system wrongly attacking and destroying insulin-producing beta cells in the pancreas. Genes may play a role in the development of some individuals [13] and viruses also triggers the immune system's response.

Type 2 Diabetes mellitus: Type 2 diabetes is caused by a mix of genetics and lifestyle factors, and it runs in families. Family members have the same genes that make them more prone to develop Type 2 diabetes and to be overweight. Excess weight, particularly in the abdomen, renders the cells more resistant to the effects of insulin on blood sugar [14].

Gestational Diabetes mellitus

Gestational diabetes is caused by hormonal changes that occur during pregnancy. The placenta secretes substances that make the cells of a pregnant woman's body less sensitive to the effects of insulin [15]. This result in elevated blood glucose levels. Women who are overweight when they get pregnant or who acquire an excessive amount of

weight throughout their pregnancy are more likely to develop gestational diabetes. Other risk factors associated with diabetes include: overweight, age above 45, physically inactive, pre diabetes, high blood pressure, High cholesterol, or high triglycerides, Heart disease, heart attack and stroke, Neuropathy, Dementia [16], and Polycystic ovary syndrome (PCOS)[17].

Pathophysiology of DM

Insulin is the primary hormone that governs the uptake of glucose from the blood into cells of the body, including liver, adipose tissue, and muscle, with the exception of smooth muscle, where insulin functions through the IGF-1 receptor (insulin-like growth factor 1) [18]. As a result, insulin insufficiency or insensitivity of insulin receptors plays a critical role in the development of diabetes mellitus in various forms.

1. The body acquires glucose from three primary sources:
2. The process through which food is absorbed through the gut.
3. The breakdown of glycogen- glycogenolysis [19].

Gluconeogenesis is the process by which glucose is produced in the body from non-carbohydrate substrates. Insulin is essential in maintaining a healthy balance of glucose levels in the body. It has the ability to block the breakdown of glycogen as well as the process of gluconeogenesis. It has the ability to stimulate the transfer of glucose into fat and muscle cells [20]. It has the potential to stimulate the storage of glucose in the form of glycogen. Insulin is released into the bloodstream by beta cells found in the islets of Langerhans in the pancreas in response to a rise in blood glucose levels, which normally occurs after eating [21]. Lower glucose levels result in decreased insulin release from the beta cell, which in turn results in the breakdown of glycogen into glucose [22]. This mechanism is primarily controlled by the hormone glucagon, which operates in the opposite direction of insulin. If the amount of insulin available is insufficient. If cells do not respond well to the effects of insulin [23], If the insulin itself is a detective. The glucose will not be efficiently absorbed by the cells of the body in this case. The overall result is consistently high levels of blood glucose, inadequate protein synthesis, and the breakdown of fat storage [24]. When the glucose concentration in the blood remains high for an extended period of time, the kidneys will reach a threshold of reabsorption glycosuria. The increase in the osmotic pressure of the urine polyuria resulted in an increase in fluid loss. Loss of blood volume will be restored osmotically by water stored in body cells and other body compartments as a result of polydipsia-induced dehydration [25].

Classification of diabetes mellitus

Type I Diabetes Mellitus (Insulin Dependent Diabetes Mellitus): Type 1 diabetes is an autoimmune disease. The immune system attacks and destroys cells in the pancreas, where insulin is made. It is not known what causes this attack. This kind of diabetes affects approximately 10% of those who have it. This is more common among children and young adults [26].

Type 2 Diabetes Mellitus (Insulin Dependent Diabetes Mellitus): Type 2 diabetes mellitus is also referred to as adult-onset diabetes. The increasing insulin secretion deficiency in the context of insulin resistance. People who have this kind of diabetes are frequently resistant to the action of insulin [27].

Gestational Diabetes Mellitus

Gestational Diabetes Mellitus is a kind of diabetes that occurs during pregnancy. It is defined as elevated blood sugar levels throughout pregnancy. This kind of diabetes is caused by insulin-inhibiting substances generated by the placenta [28].

Prediabetes Mellitus

Prediabetes Mellitus is a kind of diabetes. It occurs when blood sugar levels are higher than normal, but not high enough to justify a diagnosis of Type 2 diabetes. Diabetes insipidus is a rare illness that is not related to diabetes

mellitus, despite the fact that the two conditions share the same name. It is a distinct disorder in which your kidneys drain an excessive amount of fluid from your body.

Other Specific Type (Monogenic Types)

The most prevalent type of monogenic type of diabetes is caused by mutations on chromosome 12 in a hepatic transcription factor known as hepatocyte nuclear factor (HNF)-1a. They are sometimes referred to as genetic disorders of beta cells [29].

Symptoms of DM

Diabetes symptoms are caused by rising blood sugar. The general symptoms of diabetes include

- Increased hunger
- Increased thirst
- Weightloss
- Frequenturination
- Blurry vision
- Extreme fatigue
- Sores that don't heal [30].

Diagnosis of DM

The identification of patients with diabetes or pre-diabetes by screening allows for earlier intervention, with potential reductions in future complication rates, although randomized trials are lacking to definitively show benefit. The fasting plasma glucose (FPG) test measures the blood sugar after fasted for 8 hours. The A1C test provides a snapshot of the blood sugar levels over the previous 3 months. The following tests are used in the diagnosis of both types of Diabetes.

- Random Plasma Test
- Fasting Plasma Glucose Test
- Oral Glucose Tolerance Test
- Glycated Proteins
- Glycated Hemoglobin
- Fructose Amine Test [31].

Diagnosis of Gestational Diabetes Mellitus

At least 6 weeks after the pregnancy ends, the woman should receive an oral glucose tolerance test and be reclassified as having diabetes, normal glucose tolerance, impaired glucose tolerance, or impaired fasting glucose [32].

Treatment of diabetes mellitus

Type1 Diabetes Mellitus: Insulin is the main treatment for Type 1 diabetes. It replaces the hormone the body isn't able to produce. Four types of insulin are most commonly used. Differentiated by how quickly they start to work, and how long their effects last: Rapid-acting insulin starts to work within 15 minutes and its effects last for 3 to 4 hours. Short- acting insulin starts to work within 30 minutes and lasts 6 to 8 hours. Intermediate-acting insulin starts to work within 1 to 2 hours and lasts12 to 18 hours. Long-acting insulin starts to work a few hours after injection and lasts 24 hours or longer [33].

Medication for Type 1 Diabetes Mellitus Insulin: Insulin is the most common type of medication used in Type 1 diabetes treatment. Have type1 diabetes, the body can't make its insulin. The goal of treatment is to replace the insulin that the body can't make. Insulin is also used in Type 2 diabetes treatment. It's given by injection and comes in different types [34]. The Type of insulin need depends on how severe insulin depletion is. Options include:

- Short Acting Insulin
- Rapid Acting Insulin's
- Long Acting Insulin's
- Combination Insulin's
- Amylinomimetic Drug [35].

Type 2 Diabetes Mellitus

Diet and exercise can help some people to manage Type 2 diabetes. If lifestyle changes aren't enough to lower blood sugar, need to take medication.

Medication for Type 2 Diabetes Mellitus

- Alpha Glycosidase Inhibitors
- Biguanides
- Dopamine Agonist
- DipeptidylPeptidase-4(Dpp-4) Inhibitors
- Glucagon like Peptide-1 Receptor Agonists(Glp-1ReceptorAgonists)
- Meglitinides
- Sodium Glucose Transporter(Sglt)2 Inhibitors
- Sulfonylureas
- Thiazolidinediones [36].

Gestational Diabetes Mellitus

Gestational diabetes mellitus blood sugar levels ever al times a day during pregnancy. If it's high, dietary changes and exercise may or may not be enough to bring it down. According to the Mayo Clinic, about 10 to 20 percent of women with gestational diabetes will need insulin to lower their blood sugar. Insulin is safe for the growing baby [37]. Diabetes is a condition that leads to high levels of blood glucose (or sugar) in the body. This happens when the body can't make or use insulin like it's supposed to. Insulin is a substance that helps your body use the sugar from the food you eat. There are two different types of diabetes: Type 1 diabetes and Type 2 diabetes. People with either type of diabetes need medications to help keep their blood sugar levels normal [38].

Other Drugs

People with Type 1 and Type 2 diabetes of ten need to take other medications to treat conditions that are common with diabetes. These drugs an include

- aspirin for heart health
- drugs for high cholesterol
- High blood pressure medications.

Prevention of Diabetes Mellitus

Type 1 diabetes isn't preventable because it's caused by a problem with the immune system. Some causes of Type 2 diabetes, such as genes or age, aren't under the control either. Yet many other diabetes risk factors are controllable. Most diabetes prevention strategies involve making simple adjustments to the diet and fitness routine.

If diagnosed with prediabetes, here are a few things that delay or preventType2diabetes:

- 150 minutes per week of aerobic exercises, such as walking or cycling.
- Avoid saturated and Transfats, along with refined carbohydrates in diet.
- Eat more fruits, vegetables, and whole grains.
- Eat smaller portions.
- Trytolose 7 percent of bodyweight, if overweight or obese [39].

CONCLUSION

Diabetes mellitus is a serious complication in today's life. The lifestyle and day-to-day circumstances play a major role in occurring this type of serious complications. Diabetes mellitus is a life-threatening disease and caused 5.1 million deaths in 2013 and its prevalence is increasing very fast. In 2013, 382 million people were diabetic, and by 2035, 592millionpeople are predicted to be diabetic. To minimize its prevalence, a better understanding of the causes and pattern of prevalence of this disease will be very beneficial in the future. In low and middle-income countries like India, combined efforts of government and stakeholders of the society will be very helpful reduce its burden. Hence it was concluded from the study that there is a need to educate and improve disease awareness among the patients and it is also important in the early diagnosis and management of this endocrine disorder.

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RESEARCH ARTICLE

Influence of Exercise in the Absorption of Vitamin D among Professional Athletes with Deficiency or Insufficiency of Vitamin D Levels in the State of Kerala

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ABSTRACT

The Vitamin D levels are most independent of many of the factors that were considered to be influencing the serum Vitamin D levels. This gave birth to a new ideology about the behaviour of the serum Vitamin D levels among different nationals. The present study was done to find the influence of "High Intensity Vigorous Exercise Protocol [HIVE - Protocol]" in the absorption of Vitamin D among Vitamin D deficient and insuffiient athletes from two districts of Kerala state. 73 subjects were randomized in to two groups, with 37 patients were allotted to group A and 36 to group B. 8 Sports Academies in the districts of Malappuram and Kozhikode (4 each) were taken into study. Routine Conventional Sports Specific Exercise Training Program are administered for both the groups and the Specially designed "High Intensity Vigorous Exercise Protocol [HIVE - Protocol] is administered to the group B alone. 25-Hydroxy Vitamin D levels and SF-12-Quality of life scale (SF-12-QOL) were used as outcome measures. The distribution of 25(OH) D between the groups didn't show any significant difference between the groups. The within group analysis of group A and group B shows significant difference between the pre-test values and post-test values for SF-12- PCS score, whereas SF-12- MCS values shows no significant difference in group A. Vitamin D values within group A and group B shows significant difference between the pre-test values and post-test values. Both group A intervention and group B intervention were effective in improving the quality of life and Vitamin D levels among athletes. Group B intervention

has a marginal advantage over group A in terms of improvement in 25-Hydroxy Vitamin D levels and mental health in quality of life.

Keywords: Vitamin D, athletes, 25-Hydroxy Vitamin D levels, SF-12-Quality of life scale, HIVE Protocol

INTRODUCTION

The Vitamin D levels are most independent of many of the factors that were considered to be influencing the serum Vitamin D levels [1]. This gave birth to a new ideology about the behaviour of the serum Vitamin D levels among different nationals. On the other hand the athletes are also not aware about the various causes of Vitamin D deficiency [2,3]. They are not aware about the fact that Vitamin D deficiency can cause generalised body pain and there by influence the performance level [4]. Previous studies showed that more professional athletes were very concerned about vulnerability to skin cancer risk when exposed to sun than the concern about their Vitamin D status when not exposed to sunlight [5]. Yet despite this serious concern of skin cancer, most of the athletes' practices in the sun, but they heavily depend on the sun screen lotions for protecting the skin form UVR which they consider the major risk factor for their risk of skin cancer. The important thing to note here is the risk of Vitamin D deficiency in doing so is also a potential problem which may end their career though not abruptly but insidiously and steadily [6]. In the experience of the primary researcher in educating the athletes on Vitamin D requirements there are lots of unanswered questions raised by the audience which needs to be attested by research. The major question would be pertaining to the source of Vitamin D, signs and symptoms of Vitamin D deficiency and monitoring systems in Vitamin D. All these questions can be answered with accuracy and validity. But there are few questions we felt challenging are been taken as objective in the current study. The major questions the athletes raise in such orientation classes is, what exercises should be adopted to improve Vitamin D absorption, can exercise impact Vitamin D absorption, can Vitamin supplements with specific exercises impact the Serum Vitamin D levels more compared to supplements and conventional training, how the effect of supplementation will decay over a period of time after the stoppage of the Vitamin D supplementation. We compiled this entire question as a research problem and framed the research question based on the problem thus obtained. The Aim of this study was to find the influence of "High Intensity Vigorous Exercise Protocol [HIVE - Protocol]" in the absorption of Vitamin D among Vitamin D deficient athletes from two districts of Kerala state.

METHODOLOGY

The athletes were recruited from 8 sports academies. 97 subjects who fitted into the inclusion and exclusion criteria were taken into study and assessed for Vitamin D deficiency and insufficiency. And out of 97 subjects assessed 73 were found to be insufficient / deficient in vitamin D levels.73 subjects were randomly allotted to Group A and B .Allocation ratio was 1:1 where 37 patients were allotted to group A and 36 to group B. Subjects who were not willing to adopt the exercises protocol, subjects who had an immediate approaching event or competition, Subjects who were not willing to take Vitamin D supplements were excluded from the study. 8Sports Academies in the districts of Kozhikode and Malappuram (4 each). All the subjects signed an informed consent in their convenient language either in Malayalam or English. The outcome measures used for the study were one objective bio marker and another subjective a quality of life scale [7]. They were 25-HydroxyVitamin D levels and SF-12-Quality of life scale (SF-12-QOL). (7) As a fasting specimen was recommended, the athletes gave a fasting blood sample. The SF-12-QOL Questionnaire were analysed for the subjects by providing them the online assessment link "https://orthotoolkit.com/sf-12/" which they were asked to perform at their own place with their mobile or laptop/ desktop through the link which is being provided to them and forward the same to the primary researcher's E-Mail ID with mention of their specific allotted code number. The study consists of two important steps: generating an unpredictable random sequence and followed by implementing the sequence in a way that conceals the treatments until patients have been formally assigned to either of the groups. Methods of generating a random allocation

sequence include using a random-numbers table method that generates the random sequence. Sequentially numbered, opaque, sealed envelopes were used for concealment. The data feeder of SF -12-QOL score was blinded. A person who was not part of the intervention was used as data feeder to enter the SF-12-QOL score values directly into the master chart to avoid data manipulation and human error. Routine Conventional Sports Specific Exercise Training Program are administered for both the groups and the Specially designed "High Intensity Vigorous Exercise Protocol [HIVE - Protocol] as detailed in Appendix- I, is administered to the group B alone.

Statistical Methods

The statistical data for the study were analysed using SPSS software. The significance level was fixed as 0.005 at a confidence interval of 95% for all the group analysis. Between groups analysis for parametric data were performed using independent t-test and for non-parametric data Mann-Whitney Test was done. For the within group analysis of non-parametric data Wilcoxon Signed Ranks Test was used and Paired t-test was used for parametric data. Chi Square analysis was used find the homogeneity among groups in terms of demographic data.

RESULTS

Participant flow chart in Figure 1 shows subjects in each group, the numbers of participants who were randomly assigned, received intended treatment and were analysed for the primary outcome. There were only 3 temporary drop outs from the groups after the intervention had commenced, two subjects were from group A[1 relocated and other had malaria] and one subject from group B [grade I ankle injury (Lateral ligament)]. The primary researcher did not resume the intervention immediately for the latter two subjects as he felt these data will contaminate the study results. Hence the subjects with malaria and ankle injury who dropped for a brief period momentarily, started training after 25 days of proving their fitness. Table 1 shows the baseline demographic characteristics for each group. The distribution of 25 (OH) D between the groups didn't show any significant difference between the groups with the chi-square statistic value of 0.023 and a p-value of 0.961.The between group analysis of the SF-12-QOL Questionnaire was dealt with two parts SF-12- MCS and SF-12- PCS. The non-parametric analysis was performed to assess SF-12- PCS values which revealed that there was a significant difference between the group A and B with group A having a better scores with a mean rank value of 42.44 compared to 30.56 of group B with a p value of 0.016. Table 2 shows the between group analysis of Ranks for the pre-test values of SF-12- PCS and Table 3 shows the between group analysis of Test Statistics for the pre-test values of SF-12- PCS. The analysis of SF-12- MCS values revealed that there was a significant difference between the group A and B with group A having a better scores with a mean rank value of 46.83 compared to 26.17 of group B with a p value of 0.001. (Table 2& 3).The analysis of Vitamin D revealed that there was no significant difference between the group A and B with a mean value of 23.38 compared to 23.71 of group B with a p value of 0.688. (Table 4 & 5).

Between Group Analysis of Post-Test Values of Sf-12- PCS and MCS and Vitamin D

The Graphical representation for between Group Analysis of Pre and Post Mean Values of SF-12-PCS and-MCS and Vitamin D levels are shown in Figure 2.The non-parametric analysis was performed to assess post-test values ofSF-12- PCS which revealed that there was no significant difference between the group A and B with a mean rank value of 40.79 compared to 32.21 of group B with a p value of 0.082. The non-parametric analysis was performed to assess post-test values of SF-12- MCS which revealed that there was no significant difference between the group A and B with a mean rank value of 33.82 compared to 39.18 of group B with a p value of 0.277. The parametric analysis between the group was performed to assess post test values of Vitamin D values which revealed that there was no significant difference between the group A and B with a mean value of 37.96(3.9) compared to 40.455(3.9) of group B with a p value of 0.820 as detailed in Table 4and Table 5.

Within Group Analysis of Group A: The Graphical representation for Within group Mean Values of Pre, Post and Follow up SF-12-PCS, MCS and Vitamin D in Group A are shown in Figure 3. The within group analysis of group A

shows that There was a significant difference between the pre-test values and post-test values for SF-12- PCS score with a Z score of -5.288 and a P value of 0.001. Table 6 shows the within group analysis of Ranks in Group A for SF-12- PCS values and Table 7 displays the within group analysis of Test Statistics in Group A for SF-12- PCS values. The within group analysis for SF-12- MCS values of group A shows that there was no significant difference between the pre-test values and post-test values Z score of -0.475 and a P value of 0.635. Table 6 shows the within group analysis of Ranks in Group A for SF-12- MCS values and Table 7 shows the within group analysis of Test Statistics in Group A for SF-12- MCS values. The within group analysis for Vit D values of group A shows that there was a significant difference between the pre-test values and post-test values T score of -11.319 and a P value of 0.001. Table 8 shows the within group analysis of Paired Sample Statistics in Group A for Vit. D values, Table 9 shows the within group analysis of Paired Sample Correlations in Group A for Vit. D values and the Table 9 shows the within group analysis of Paired Sample Test in Group A for Vit. D values.

Within Group Analysis of Group B: The Graphical representation for Within group Mean Values of Pre, Post and Follow up SF-12-PCS, MCS and Vitamin D in Group B are shown in Figure 4. The within group analysis of group B shows that There was a significant difference between the pre-test values and post-test values for SF-12- PCS score with a Z score of -5.153 and a P value of 0.001. Table 6 shows the within group analysis of Ranks in Group B for SF-12- PCS values and Table 7 displays the within group analysis of Test Statistics in Group B for SF-12- PCS values. The within group analysis for SF-12- MCS values of group B shows that there was a significant difference between the pre-test values and post-test values Z score of -2.891 and a P value of 0.004. Table 6 shows the within group analysis of Ranks in Group B for SF-12- MCS values and Table 7 shows the within group analysis of Test Statistics in Group B for SF-12- MCS values. The within group analysis for Vit D values of group B shows that there was a significant difference between the pre-test values and post-test values T score of -41.808 and a P value of 0.001. Table 8 shows the within group analysis of Paired Sample Statistics in Group B for Vit. D values, Table 9 shows the within group analysis of Paired Sample Correlations in Group B for Vit. D values and the Table 9 shows the within group analysis of Paired Sample Test in Group B for Vit. D values.

DISCUSSION

This study aimed to find the influence of exercise in the absorption of Vitamin D among athletes from two different districts of Kerala namely Kozhikode and Malappuram. The athletes selected were identified with Vitamin D deficiency through a previous cross sectional study. The main objective of the study was to find the effect of Vitamin D supplements and routine conventional sports specific exercise training program in the absorption of serum Vitamin D and quality of life among the athletes from these two States. The next objective was to find the effect of Vitamin D supplementation and specifically designed exercise program for this study which was named as "High Intensity Vigorous Exercise Protocol [HIVE - Protocol]" and conventional sports specific exercise training program in the absorption of Vitamin D level and also to find the quality of life among athletes with Vitamin D deficiency from these two selected states of Kerala. And finally the study also had an objective of comparing the effect of Vitamin D supplements between routine conventional sports specific exercise program and the "High Intensity Vigorous Exercise Protocol [HIVE - Protocol]" which was specifically designed for the study. Results of the study showed that both the group was highly homogenous. It was proved by the baseline values of both the groups and also the demographic data of both the groups. In the demographic data analysis there was no significant difference between both the groups in terms of sex distribution, age distribution, games involved, practice area, years of experience, hip waist ratio, BMI distribution and Vitamin D levels. Hence for any changes in the variable relationship demographic data would have not been responsible.

Secondly, the baseline analysis of the outcome measures for both the groups was done which show that there was no significant difference between the Vitamin D values in both groups at the start of the intervention. However there was a significant difference between the SF-12- MCS and SF-12- PCS values which was really marginal. It can be argued that with all other parameters having no significant difference, the difference that existed between the

nonparametric scales can be considered as negligible else as not significant. The between group analysis of the post-test values of both the groups show that there was no significant difference between the group A and group B for SF-12- PCS value and SF-12- MCS value. In the analysis of the Vitamin B there was no significant difference between group A and group B with group B scoring more than group A [8]. In the within group analysis of group A there was a significant difference between the protest and post-test values for SF-12- PCS scores, but there was no significant difference between the SF-12- MCS values in group A. Within group analysis of group A Vitamin D level show that there was a significant difference between the pre-test and post-test values. In the within group analysis of group B there was a significant difference between the pre-test values and post-test value for SF-12- MCS and SF-12- PCS values. And also there was a significant difference existed in the Vitamin D levels. This clearly states that group B intervention has a superior effect over the group A. To sum up between group values did not show much difference between the group A and group B but the within group difference was better for group B compared to group A. This was consistent to previous study results [9,10,11].

CONCLUSIONS

From this study it is concluded that both group A intervention and group B intervention were effective in improving the quality of life and Vitamin D levels among athletes. Group B intervention has a marginal advantage over group A in terms of improvement in Vitamin D levels and mental health in quality of life. It is also concluded from this study that with only marginal difference existing between the two interventions in short term, it is always advisable to go for a long term benefit analysis to find out the retain ability of the improvement gained through both the intervention protocol.

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Table 1: Baseline demographic characteristics and Vitamin D level.

Characteristics	Group A	Group B
No of subjects allotted	37	36
Age (Mean & SD)	21.78(4.7)	21.08(3.4)
Sex ratio	Male: 21 Female:16	Male: 27 Female : 9
Games	Football – 26 Cricket - 1 Volley ball - 3 Track event - 3 Field event – 4	Football – 20 Cricket - 6 Volley ball – 6 Track event - 1 Field event – 3
Practice area	Outdoor – 35 Indoor – 2	Outdoor – 36 Indoor – 0
Years of experience	6.59 (3.6)	6.05 (2.6)
HW Ratio	Waist - 31.45(3.2) Hip -37.0811(3.5) Ratio - 0.8(0.1)	Waist - 32.13(2.03) Hip - 37.66(2.9) Ratio - 0.85(0.05)
BMI	163.22(6.56) 62.89(4.40) 23.6(1.17)	164.61(6.4) 63.38(4.6) 23.39(1.2)
25(OH)D ng/mL	23.38 (4.3)	23.71(4.4)

Table 2: Between group analysis of Ranks for SF-12 Scores

	SF-12 – PCS				SF-12 – MCS			
	Pre Test		Post Test		Pre Test		Post Test	
	Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B
N	37	36	37	36	37	36	37	36
Mean Rank	42.44	30.56	40.79	32.21	46.83	26.17	33.82	39.18
Sum of Rank	1528	1100	1468.5	1159.5	942	1686	1217.5	1410.5

Table 3: Between group analysis of Test Statistics for SF-12 Scores

	SF-12- PCS		SF-12- MCS	
	Pre Test	Post test	Pre Test	Post test
Mann-Whitney U	434	493.5	276	551.5
Wilcoxon W	1100	1159.5	942	1217.5
Z	-2.41	-1.741	-4.19	-1.087
Asymp. Sig. (2-tailed)	0.016	0.082	0	0.277

Table 4: Between group analysis of Vitamin 'D' Level

	Pre Test		Post Test	
	Group A	Group B	Group A	Group B
N	37	36	37	36
Mean	23.3810	23.7111	37.9694	40.4556
Std. Deviation	4.32787	4.49277	3.97174	3.90666
Std. Error Mean	0.71150	0.7488	0.66196	0.65111

Table 5: Between Group Independent Samples Test for Vitamin 'D' levels

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Pre-Vitamin D	Equal variances assumed	0.162	0.688	-0.416	70	0.679	-0.4333	1.04143
	Equal variances not assumed			-0.416	69.919	0.679	-0.4333	1.04143
Post-Vitamin D	Equal variances assumed	0.052	0.82	-2.678	70	0.009	-2.4861	0.92851
	Equal variances not assumed			-2.678	69.981	0.009	-2.4861	0.92851

Table 6: Within Group Analysis of Ranks for SF-12 Scores

	Group A - Pre and Post SF-12				Group B - Pre and Post SF-12			
	PCS Rank		MCS Rank		PCS Rank		MCS Rank	
	Negative	Positive	Negative	Positive	Negative	Positive	Negative	Positive
N	1	36	19	18	2	34	24	12
Mean Rank	1	19.5	16.84	21.28	2.5	19.44	21.54	12.42
Sum of Ranks	1	702	320	383	5	661	517	149

Table 7: Within group Test Statistics for SF-12 Scores

	Group A -Pre and Post SF-12		Group B -Pre and Post SF-12	
	PCS	MCS	PCS	MCS
Z	-5.288	-0.475	-5.153	-2.891
Asymp. Sig. (2-tailed)	0	0.635	0	0.004

Table 8: Within Group Paired Samples Statistics of Vitamin'D' Level

Group	Vitamin D	Mean	N	Std. Deviation	Std. Error Mean
A	Pre Test	23.381	37	4.32787	0.71150
	Post Test	37.969	37	3.97174	0.66196
B	Pre Test	23.711	36	4.49277	0.7488
	Post Test	40.456	36	3.90666	0.65111

Table 9: Within Group Paired Samples Correlations for Vitamin 'D' levels

Group	Vitamin D	N	Correlation	Sig.	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		T	Df	Sig. (2-tailed)
								Lower	Upper			
A	Pre & Post	37	0.312	0.06	-13.562	7.288	1.198	-15.992	-11.132	-11.32	36	0
B	Pre & Post	36	0.845	0	-16.744	2.403	0.405	-17.557	-15.931	-41.81	35	0

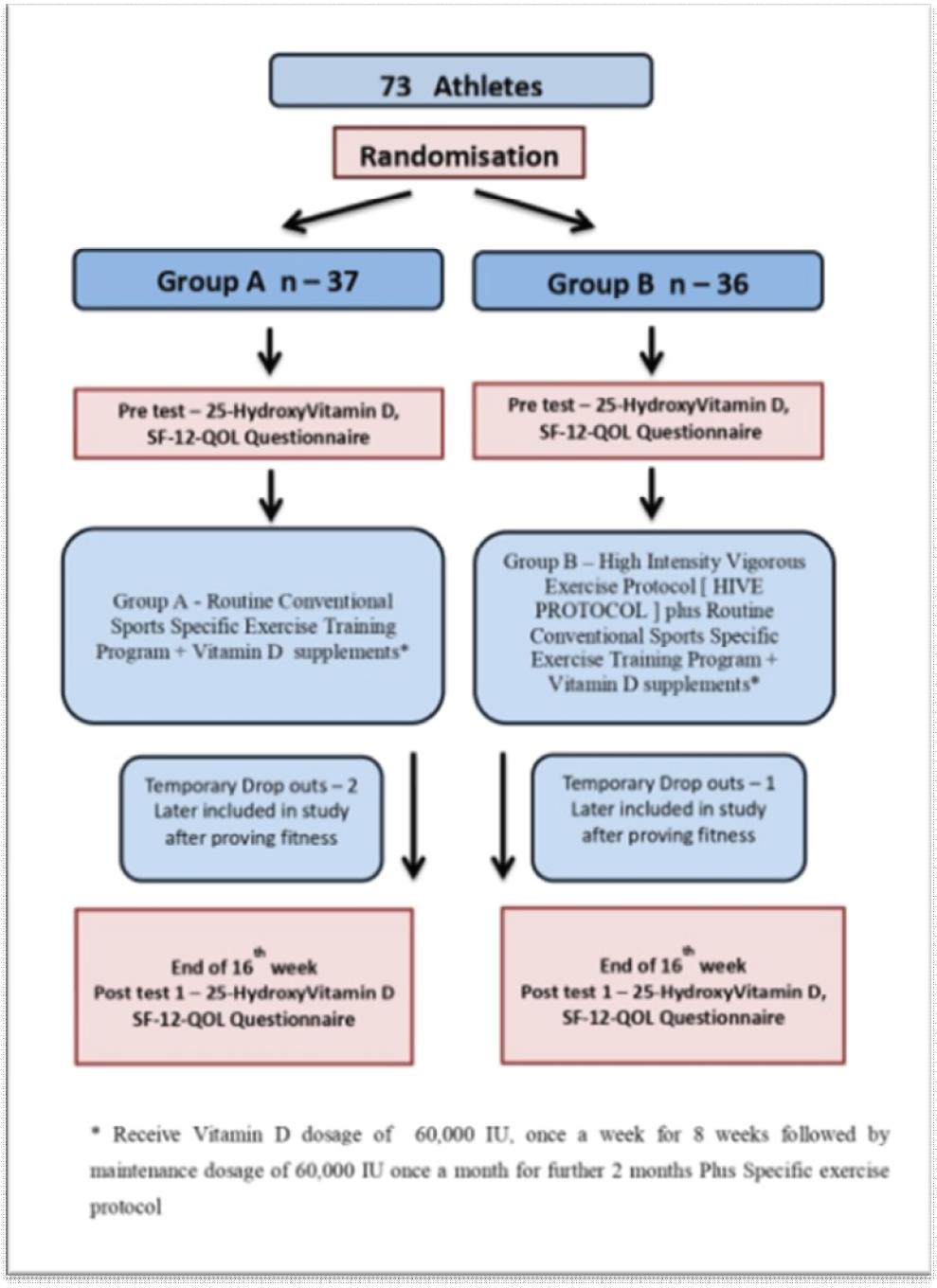

Figure 1: Flow chart of Methodology

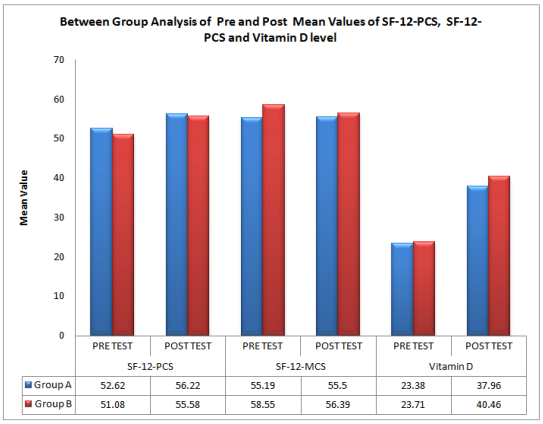

Figure 2: Graphical represention for Between Group Analysis of Pre and Post Mean Values of SF-12-PCS, SF-12-PCS and Vitamin D level

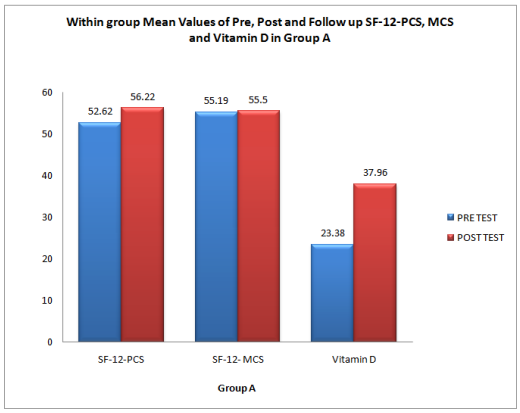

Figure 3: Graphical represention for Within group Mean Values of Pre and Post SF-12-PCS, MCS and Vitamin D in Group A

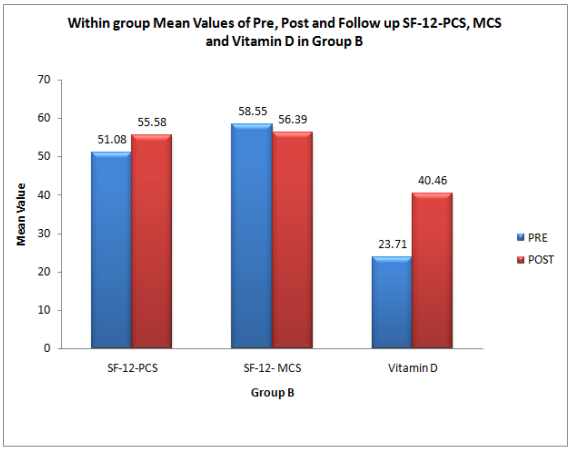

Figure 4: Graphical representation for Within group Mean Values of Pre and Post SF-12-PCS, MCS and Vitamin D in Group B

SPECIALLY DESIGNED "HIGH INTENSITY VIGOROUS EXERCISE PROTOCOL" [HIVE PROTOCOL]

A. Tabata Workout - Total Workout Time: 35 Minutes

Includes 4 Tabata sets, each with two high-intensity exercises the athletes will alternate for the length of each set. Longer rests if needed can be taken.

Warm-up: 10 minutes cardio, gradually increasing intensity

Tabata Set 1:
1. Burpees
2. Mountain Climbers

Alternate every exercise for 20 seconds with resting 10 seconds between each and repeat the same for 8 cycles.
Resting time of 1 minute after this set

Tabata Set 2:
1. Long Jumps
2. Plyo-Jacks

Alternate every exercise for 20 seconds with resting 10 seconds between each and repeat the same for 8 cycles.
Resting time of 1 minute after this set

Tabata Set 3:
1. Squat Jumps
2. Jogging - High Knees

Alternate every exercise for 20 seconds with resting 10 seconds between each and repeat the same for 8 cycles.

Resting time of 1 minute after this set

Tabata Set 4:
1. Jump Kicks
2. Side to Side Jumping Lunges

Alternate every exercise for 20 seconds with resting 10 seconds between each and repeat he same for 8 cycles.
Resting time of 1 minute after this set then Cool down: 5 minutes

Appendix I: HIVE Protocol

B. **Dumbbell Workout - All out high power HIIT program** - Total exercise time –15 mins

Close Grip Chest Press - 30 seconds
Close Grip Chest Press with Crunch - 45 seconds

Close Grip Chest Press along with Crunch and incorporating with Leg Lowers - 75 seconds

Squat Hold - 45 seconds

Renegade Rows - 30 seconds

Weighted Walkout through to Renegade Row - 45 seconds

Weighted Walkout through to Renegade Row and then Knee Raise and Twist - 75 seconds

Squat Hold - 45 seconds

Dumbbell Over the Shoulder Chops - 30 seconds

Squat and to Over the Shoulder Chops - 45 seconds

Squat Thrust and to Over the Shoulder Chops - 75 seconds

Cool down Stretch - 45 seconds

C. The Total Body Beatdown - Set a timer for 12 minutes

Done as an "every minute on the minute" - EMOM circuit training . So the athletes will have one minute to do each move, then they will rest until the start of the next minute. The faster they finish their reps, the more time they would get to rest.
Minute 1: 15 air squats

Minute 2: 15 burpees

Minute 3: 10 lying Superman holds

Repeat this 3 minute EMOM circuit for 4 times.

Total HIVE Protocol Timing : 35x15x12 = 62 Minutes

Done 3 times a week as evening workout for the entire Intervention (4 Months)

Done 3 times a week as evening workout for the entire Intervention (4 Months)

1. FootBall Players – Tuesday/Thursday/Saturday * Every week
2. Cricket Players – Monday/Wednesday/Friday * Every week
3. Volleyball Players – Monday/Wednesday/Friday * Every week
4. Sprinters – Monday/Wednesday/Friday * Every week
5. Discuss & Shot Put Throwers– Tuesday/Thursday/Saturday * Every week

Appendix I: HIVE Protocol [Contd.]

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RESEARCH ARTICLE

Multi-Level Quasi Z Source Inverter for Control of BSS and Stable Operation of Asynchronous Motor Drive

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ABSTRACT

Multi-Level Quasi Z Source Inverter (MLqZSI) controls the force moving from PV exhibit to single – stage acceptance engine. In sun based fueled drive frameworks, primary concern is steady expected activity of drive when exposed to varieties in power age of PV exhibit. For same ecological conditions, PV power extraction is distinctive at various forces for consistent speed application. Because of this, extraction of most extreme force with Maximum Power Point Tracking (MPPT) calculation isn't accomplished with just engine load. Indisputably, plan of control calculation should resolve issues of MPPT calculation, control of battery stockpiling framework and stable activity of V/f – controlled acceptance engine drive activity. MATLAB/Simulink model of the proposed framework with 4kW PV exhibit rating is created.

Keywords: Multi-Level Quasi Z Source Inverter (MLqZSI), Asynchronous motor, PV array

INTRODUCTION

The anticipated worldwide energy problem in coming a long time because of the quick decrease of petroleum derivatives [1] and a consistently reducing expenses of sun powered photovoltaic (PV) boards, semiconductor gadgets and control parts [2], invigorated the academicians and industrialists to connect for a successful use of photovoltaic innovation. Notwithstanding other PV fueled applications, an independent PV controlled water the executives framework (extraction and siphoning) is by all accounts the exceptionally compensating in regions like rustic rural water system, planting and road watering, and fish ranches [3]. The main burden associated with the utility lattice all around the world are the electric engines (generally 40% of worldwide utilization) [4]. In this way, an electrical engine assumes recognizable part to get a handle on sunlight based solid, financially savvy and effective water siphoning. An energy-effective engine power electronic converter framework altogether lessens the amount of

sunlight based PV modules for a normal force request [5]. Among the few kinds of engines, dc engines are generally reasonable for sun oriented PV water siphoning applications however have genuine downsides of standard upkeep of commutators and brushes [3]. Moreover, the brushless dc (BLDC) engine is appropriate for the sun based PV based water siphoning frameworks in light of its minimization, tough construction, practically free support, wide scope of speed control and basic control [6] – [8]. In any case, it experiences genuine disadvantages at framework level, for example, two phase power change, halfway concealing of PV boards and temperature [9]. These raises serious worries on working and appropriate activity of the water pump. In [10], creator proposed the SRM drive for the water siphoning applications. To defeat every one of the past referenced issues single-stage acceptance engine is recognized as a superior substitute for PV water siphoning framework [11]. Single-stage acceptance engine is driven by measured energy put away Quasi Z-Source (QZS) Multilevel Inverter (MLI) [12]-[13], to work in every one of the climate conditions with maximal use of the sun oriented PV. Single-stage acceptance engine comprises of two windings (assistant and primary) put on the stator which are electrically uprooted by 900. In the helper winding, a series capacitor is added to aid production of the 900 stage contrast during beginning and to get higher beginning force. This winding is separated from the inventory when the engine comes to a predefined speed through radiating switch. This plan is known as capacitor start acceptance machine. Additionally, the helper twisting with series capacitor can keep on working even subsequent to beginning to expand the force factor of the machine in running condition. This game plan known as capacitor run single stage acceptance machine. Other variation of capacitor start-run acceptance engine, two capacitors are put in helper winding [14]. Whenever engine has arrived at pre-characterized speed, beginning capacitor is detached. Activity at variable rates requires directing sign to be variable recurrence in the mean time keeping up with stage contrast of 900 between the two windings [15]. To support twisting flows at required stage contrast, singular single-stage H-spans.

To accomplish required ac yield voltage, PWM can be utilized [16]-[18]. Something else, three leg inverter can be utilized by interfacing the two engine windings between the three legs. This is a practical solution when contrasted with utilizing two H connect as it utilizes less semiconductor segments [19]. As of late single force converter fit for accomplishing both the prerequisites of voltage boosting and upsetting to ac power are created. Z Source and semi Z Source converters accomplish both the necessary assignments. They comprise of an exceptionally planned impedance network followed by the regular H-Bridge. Shoot through method of this circuit permits boosting of the information voltage [20]. MPPT calculation for these converters are created to separate most extreme force from the PV boards. Fell staggered qZSI are created for outfitting the advantages of staggered inverter and the circulated MPPT control on each module [21]-[22]. Improvement of Cascaded qZSI for framework synchronization have been created in [23]-[24]. Every module of qZSI has its own battery energy stockpiling framework to charge during the abundance created power from PV and it tends to be released during night activity [25]. Arrangement of battery stockpiling framework is examined in writing at two distinct situations inside the qZS organization. In [26] – [28], battery stockpiling framework is set across capacitor C2 of semi organization. To keep away from activity in intermittent conduction activity of qZSI, battery releasing capacity is restricted in this arrangement [29]. Position of battery stockpiling framework across C1 is likewise introduced in the writing [29] – [31]. In any case, with sun oriented PV fueled frameworks, change in natural conditions is reflected as change in the working simple to use-through obligation cycle. Change in obligation cycle changes the voltage across capacitors and dc transport voltage. To control the current stream into the battery stockpiling framework, committed bidirectional dc-dc converter should be set to separate greatest force from PV. Furthermore, activity of engine at appraised condition under all ecological condition is guaranteed by energy the executives of battery stockpiling framework.

The System Design

Design of PV system

Plan of PV framework is represented essentially by the heap associated with the framework. In framework associated PV framework, fundamental basis is to consistently keep up with matrix synchronization. It implies center is more around keeping up with the sun based controlled inverter yield voltage near the framework voltage. Nonetheless, for sun based controlled drive frameworks, center is to keep up with the drive execution. This implies,

speed and force execution of the engine should be kept up with. Another highlight be considered is the crumbling in execution because of effect of natural conditions on PV power age. The plan steps given underneath efficiently address these issues and give plan rules to sunlight based fueled drive frameworks. Rating of single – stage enlistment engine is 3 HP, 220V. Canadian Solar CS5P-225P sun based module is utilized for acknowledgment of sun oriented board. Pinnacle power rating of the PV exhibit is 225W at 46.9V and 4.79A. To comprehend, the quantity of sun powered modules needed in the PV exhibit, current and voltage rating of each qZSI module should be resolved first. Three modules of qZSI are associated in course to give rms yield voltage of 220V. Adjustment list of 0.8 is chosen here. In this way, the information voltage needed for every module of qZSI should be:

$$Vin=\{(Vac\ rms * \sqrt{2}\ )/(M*N)\}* (1-2*D) \quad \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Subbing Vac rms = 220V, M (Modulation Index) = 0.8, N (Number of modules) = 3; D (Shoot – through obligation cycle) = 0.2, input voltage acquired is 78V. Then, at that point the current rating of the information power supply can likewise be gotten. Accepting proficiency of 80%, engine input power required ought to be $746 * 03/.8 = 2800$ Watts. This force should be provided by three fell qZSI modules, so power provided by every module is 935 Watts. Expecting 95% effectiveness of converter, input current needed from sunlight based board is 12.6A. In this way, appraising of info power supply required will be 78V, 12.6A. Hence, three modules of CS5P-225P should be associated in corresponding to give current rating of 12.6A (every current rating being 4.79A). For providing the necessary voltage, two modules should be associated in series (every voltage rating being 46.9V). Hence, the PV cluster needed at the contribution of each qZSI framework comprises of three equal PV strings with each string comprising of two series associated PV modules, which implies six modules altogether. Subsequently, appraising of PV cluster associated at the contribution of each qZSI module is 1350 Watts. The following period of configuration is to characterize the scope of sun based protection and temperature for which the engine execution is intended to work with no exhibition disintegration. To get this, PV cluster qualities for outrageous ecological conditions is thought of. Sunlight based radiation of PV cluster is shifted from 1 kW/m2 to 0.6 kW/m^2 in strides of 0.1 kW/m^2 as displayed in Fig. 1. Force needed from each board should be ≥ 985 Watts. Accordingly, for power age over 700 W/m^2 , no weakening in the drive execution should be noticed. It ought to likewise be seen that, for varieties in sun based radiation of PV exhibit, deviation in board voltage at MPPT point is < 2V. Temperature of PV cluster is changed from 25^0C to 65^0C and the attributes are plotted in Fig. 2. No deviation in board current is noticed for variety of board temperature. To think about the concurrent variety of temperature and sun oriented light, Fig. 3 is plotted to distinguish the steady district of activity. From the chart, it very well may be presumed that the single – stage drive can work acceptably at appraised condition in the following ranges:
i) For 25^0C, solar irradiation range is 1 – 0.72 kW/m^2. ,ii) For 35^0C, solar irradiation range is 1 – 0.75 kW/m^2 , iii) For 45^0C, solar irradiation range is 1 – 0.8 kW/m^2, iv) For 55^0C, solar irradiation range is 1 – 0.83 kW/m^2 & v) For 65^0C, solar irradiation range is 1 – 0.88 kW/m^2.

Multilevel Inverter Topologies

The fundamental underlying square outline of a stage leg capacitor-braced inverter as displayed in Fig.5 where the circuit can likewise be called as flying capacitor inverter which gives a five-level yield across An and N which has set of autonomous capacitors cinching the gadget voltage to one capacitor voltage level.

RESULTS AND DISCUSSIONS

By considering research center model of diode braced 3-level inverter the test results were determined where a DC-Link Voltage of 100 volts and DC-Link capacitance of 2200uF and for Inductive Load a Resistance of 10ohm and inductance worth of 160mH are utilized as. Furthermore, yield waveform nature of Three-Level Inverter at MI worth of 0.8 is created as displayed in Fig.8. Symphonious range delights that higher even request consonant segments builds voltage and current THD because of huge unbalance in DC-connect voltages. The stage voltage THD versus

MI for SVM-1 and SVM-2 are plotted in Fig.9. Where the abide season of little vector can be decreased at MI worth of 0.866. By parting little vector the DC-Link voltage adjusting gets wasteful. The proposed conspire is more productive and compelling to control in districts of 1 and 3 where in which two little vectors are spitted in beat design course of action for DC-Link adjusting control. Where as in locale 2 and 4 only one little vector is spitted in beat design course of action for DC-Link adjusting control. In the proposed the NPV is controlled beneath most extreme indicated esteem when contrasted with DC-Link voltage for SVM-1. Furthermore, in proposed plot the NPV of SVM-2 is similarly low to NPV of SVM-1.

CONCLUSION

Plan and execution of V/f – controlled sunlight based fueled single – stage capacitor turn over acceptance engine has been introduced. Steady speed variable force drive execution was acquired by controlling the single – stage acceptance engine through seven – level qZSI. Bit by bit method for deciding segment detail of every framework unit dependent on given single – stage enlistment engine determinations were talked about. Limitations identified with MPPT point activity of traditional sun based – controlled drive frameworks were featured. Annoy and Observe MPPT calculation was introduced for qZSI which changes the shoot – through obligation cycle to accomplish extraction of most extreme force conceivable relying on the associated load. For given rating of single – stage acceptance engine, area of activity of given PV cluster were characterized for appraised power activity during synchronous variety of sun based light and temperature changing all the while. Idea of battery stockpiling framework in every module was acquainted here with permit extraction of MPPT power at some random natural conditions. With the proposed control calculation applied to the proposed geography, extraction of pinnacle power at some random ecological conditions was accomplished with the electric drive achieving V/f controlled consistent speed variable force activity. Likewise, when PV power age is not exactly appraised engine contribution (because of incomplete concealing, cloud, morning hours or temperature variety), battery stockpiling framework supplies power deficiency to the engine with the goal that the engine consistently works at evaluated power.

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Table [1]: Operation Modes for Reference voltage and output voltage

Operating Mode	Reference voltage range	Output voltage
Mode 1	$Vc \leq V_{ref} < 2V_c$	$V_{dc}/2$ or V_{DC}
Mode 2	$0 \leq V_{ref} < V_c$	0 or V_{DC}
Mode 3	$-Vc \leq V_{ref} < 0$	$-V_{dc}/2$ or 0
Mode 4	$2Vc \leq V_{ref} < -V_c$	$-V_{dc}$ or $-V_{DC}/2$

Table [2]: Output voltage & Switching states

Output Voltage	Switching condition					
	S1	S2	S3	S4	T1	T2
V_{DC}	ON	OFF	OFF	ON	ON	ON
V_{DC}	ON	OFF	OFF	ON	OFF	ON
	ON	OFF	OFF	ON	ON	OFF
0	ON	OFF	OFF	ON	OFF	OFF
	OFF	ON	ON	OFF	OFF	OFF
$-V_{DC}/2$	OFF	ON	ON	OFF	OFF	ON
	OFF	ON	ON	OFF	ON	OFF
$-V_{DC}$	OFF	ON	ON	OFF	ON	OFF

Table 3: Simulation Parameters

Simulation Parameters	Symbol	Values
Sun Irradiance	Ir	1000 W/m^2
Temperature	T	24 deg C
Diode	D,D1,D2	0.8V
RL	R1,R3,R5	(0.01 ohms,0.075H)
RC	R7,R8,R9	(0.01,0.1F)
Capacitor	R12,R15,R16	0.1F
Inductor	R11,R13,R17	0.075H
Single phase Asynchronous motor	Single phase Asynchronous motor	186.5VA,110V,60Hz

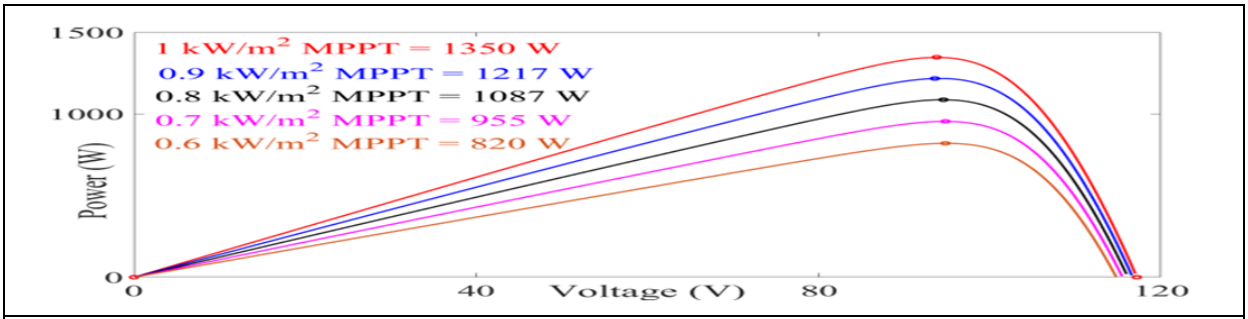


Fig 1: Power generation at different Solar radiations at 25⁰C.

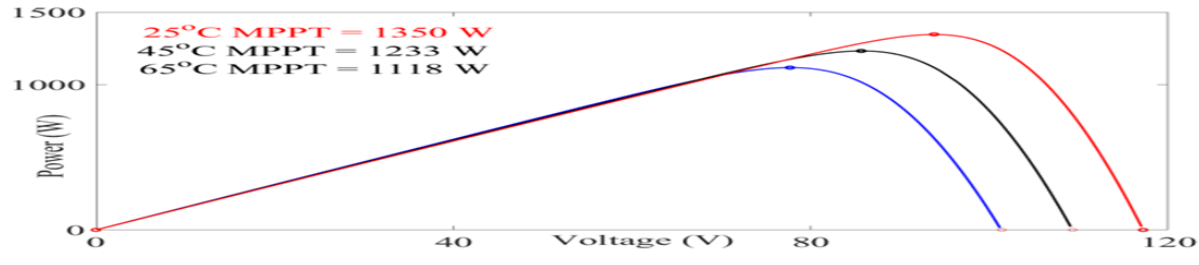


Fig 2: Power generation at different temperature at 1 kW/m²

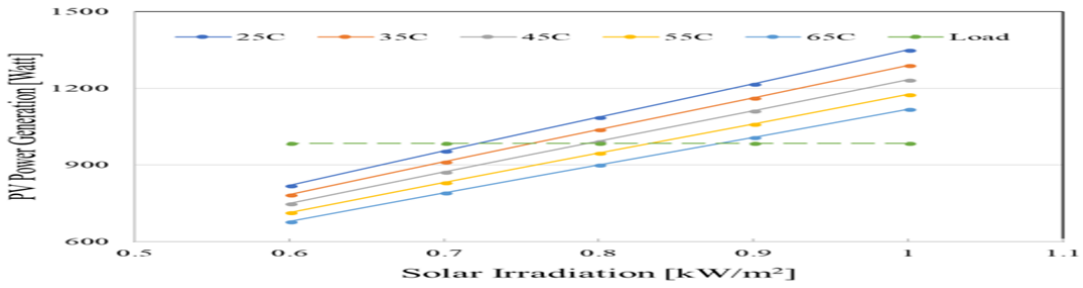


Fig 3: Region of PV power generation for stable operation of single – phase Asynchronous motor at rated condition.

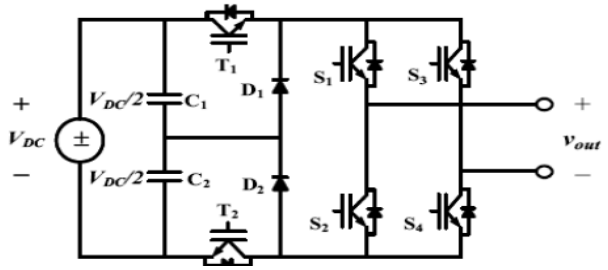


Fig 4: Multi level Inverter.

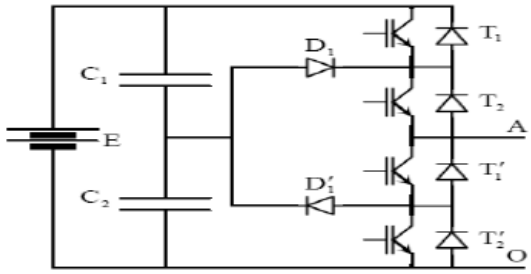


Fig 5: Three-level Capacitor-Clamped Multilevel inverter

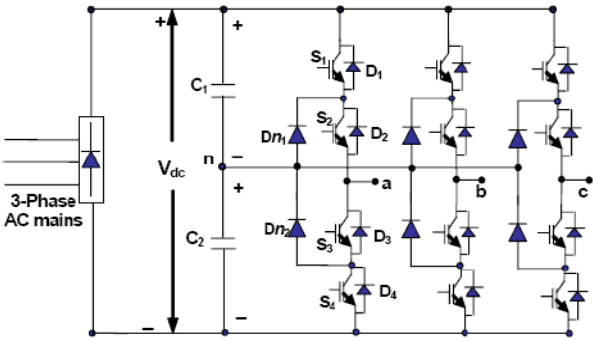


Fig 6: Three-level neutral-point clamped inverter topology.

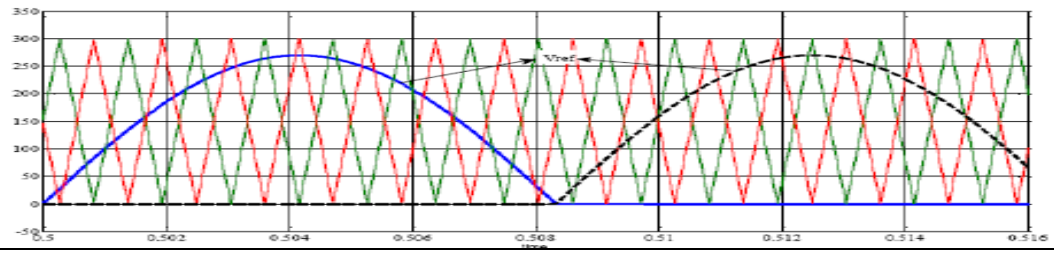


Fig 8: 3-level inverter Output waveform

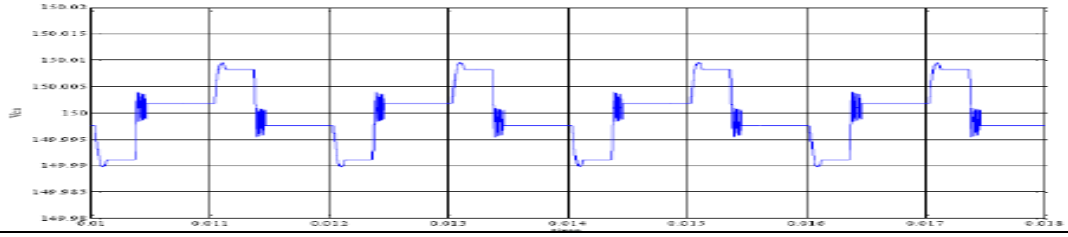


Fig 8: Quality of the 3-level inverter's space-output waveform (capacitor voltage V_{ca} at PF=0.9)

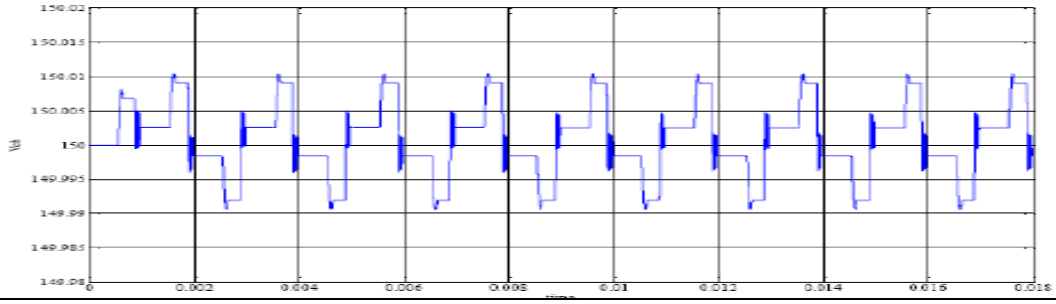


Fig 9: plot of phase voltage THD versus MI for SVM-1 and SVM-2 (capacitor voltage V_{cb} at PF=0.9).

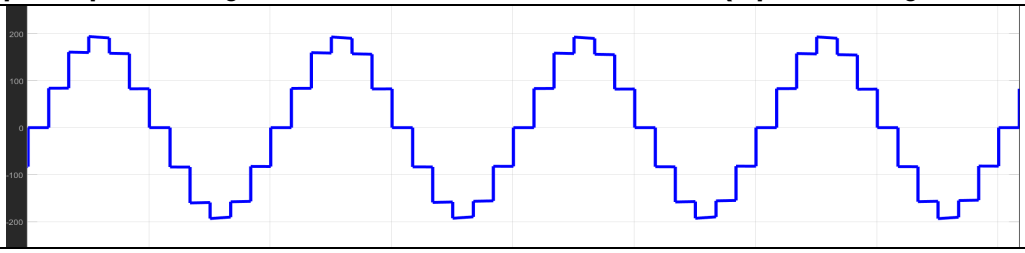


Fig 10: Output Voltage

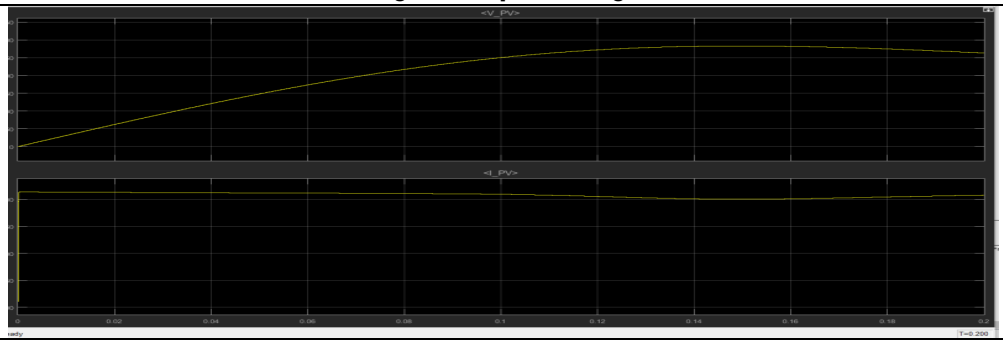


Fig 11:Solar output voltage and current 1

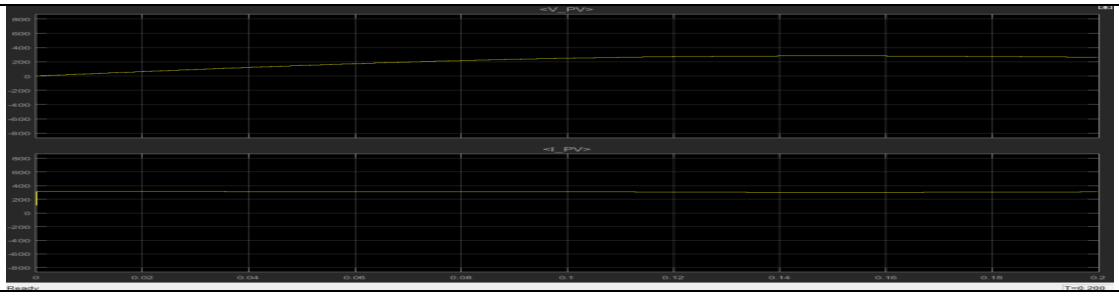


Fig 12:Solar output voltage and current 2

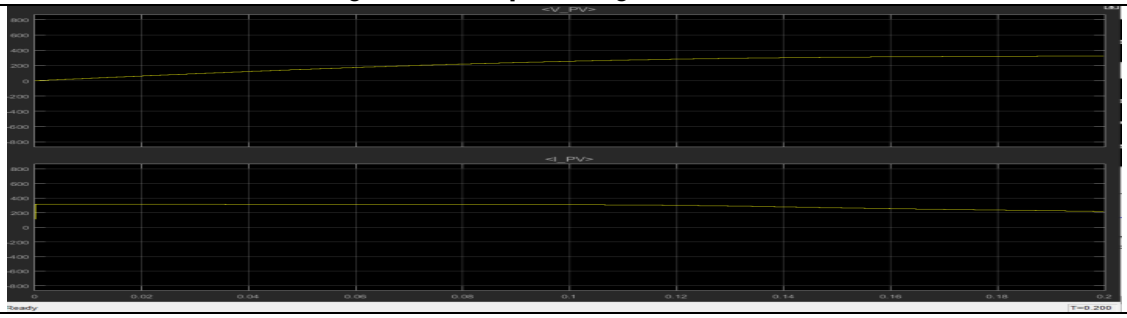
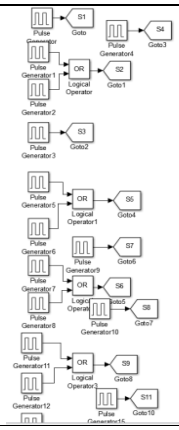


Fig 13:Solar output voltage and current 3



	0	5	10	15	10	5	0	-5	-10	-15	-10	-5
S1	1	1	1	1	1	1	1	0	0	0	0	0
S2	1	0	0	0	0	0	1	1	1	1	1	1
S3	0	0	0	0	0	0	0	1	1	1	1	1
S4	0	1	1	1	1	1	0	0	0	0	0	0
S5	1	1	1	1	1	1	1	1	0	0	0	1
S6	1	1	0	0	0	1	1	1	1	1	1	1
S7	0	0	0	0	0	0	0	0	1	1	1	0
S8	0	0	1	1	1	0	0	0	0	0	0	0
S9	1	1	1	1	1	1	1	1	1	0	1	1
S10	1	1	1	0	1	1	1	1	1	1	1	1
S11	0	0	0	0	0	0	0	0	0	1	0	0
S12	0	0	0	1	0	0	0	0	0	0	0	0

Fig 14: Switching Technique

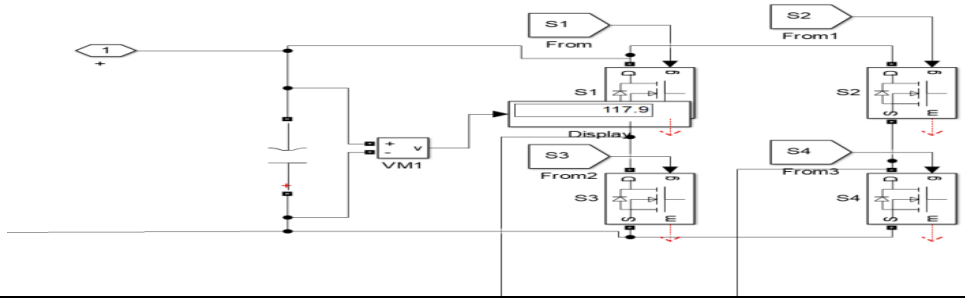


Fig 15: Inverter Switching Position

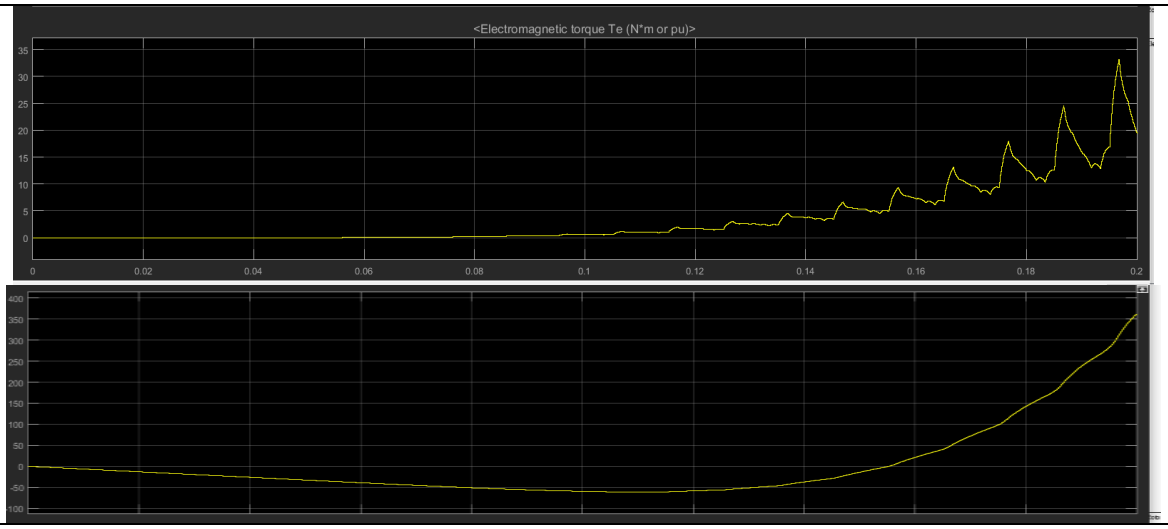


Fig 16: Rotor speed output

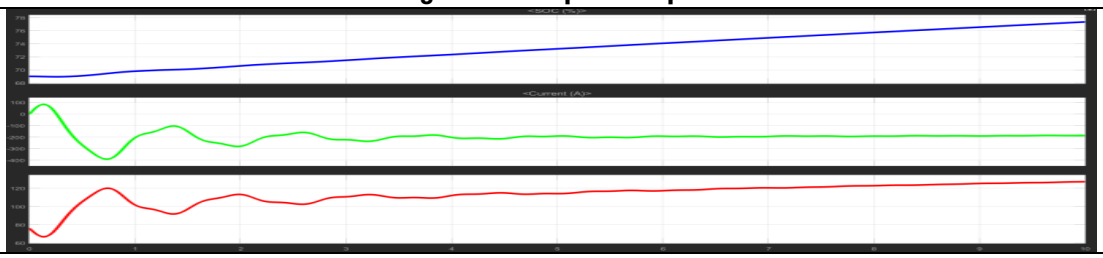


Fig 17: Battery Status

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RESEARCH ARTICLE

Wireless Programmable Functional Electrical Stimulation to Correct Foot Drop Syndrome

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ABSTRACT

The stimulator has been designed to make correction on the foot drop syndrome, which is called wireless functional electrical stimulation device. In the traditional FES systems, sensors are placed inside the shoe sole which are connected to a stimulator device using lead wires or cables. One of the biggest disadvantages of the cabled systems is the cable complexity, and also device giving discomfort to the patient during the walking, because of the cables around the shoe and the foot. The system designed by the author is wireless and was developed by removing this cables from the device and by using Radio Frequency (RF) transmitter/receiver pair to connect the sensors to the stimulator device. For this reason, the patients can use this device more comfortably, and easier. In the design of the wireless functional electrical stimulation device, a force sensitive sensor, programmable microcontroller, transmitter, receiver and electrodes are used. Stimulation amplitude, duty cycle, and frequency of the output waveform can easily be adjusted by using switches. Also design has been developed further by the addition of another second in-sole foot sensor underneath the metatarsal heads so that device enabled reliable sensing in addition to walking on straight surfaces during the stair climbing. The cost of the overall system is very low, because during the development process standard microcontroller development systems, standard electronic equipment's and standard wireless components were used which are easily found in the market.

Keywords: Foot sensors, Wireless functional electrical stimulation, Foot drop syndrome.

INTRODUCTION

The patient cannot move his/her foot upward the ankle or toes. Foot drop correction is generally achieved by electric stimulation of the common peroneal nerve by sending a series of pulses at a given amplitude, duration and frequency [1] [2][8]. For this purpose, a wireless programmable microcontroller based low-power, low-cost, battery operated, high performance and portable electronic stimulation device has been developed. The stimulator has been designed to make correction on the foot drop syndrome, which is called wireless functional electrical stimulation device [2][8]. In the traditional functional electrical stimulation systems, sensors are placed inside the shoe sole which are connected to a stimulator device using lead wires or cables. One of the biggest disadvantages of the cabled systems is the cable complexity, and also device giving discomfort to the patient during the walking, because of the cables around the shoe and the foot [3]. The system designed by the author is wireless and was developed by removing this cables from the device and by using Radio Frequency (RF) transmitter/receiver pair to connect the sensors to the stimulator device [5]. Drop foot syndrome is general term for difficulty lifting the front part of the foot from the ground which is a common problem that can lead to falls, trips and injuries in human life [3]. It is usually neuromuscular disorder that causes peroneal neuropathy between the neck and the fibula [6][8]. In other words, drop foot problem is the loss of communication between the peroneal nerve and central nervous system which is enables the foot to make dorsiflexion [4]. The patient cannot move his/her foot upward the ankle or toes. Foot drop correction is generally achieved by electric stimulation of the common peroneal nerve by sending a series of pulses at a given amplitude, duration and frequency [7]. For this purpose, a wireless programmable microcontroller based low-power, low-cost, battery operated, high performance and portable electronic stimulation device has been developed [5].

PROPOSED METHODOLOGY

The proposed method block diagram is as shown in figure1.

Battery: The energy released during accepting an electron by a neutral atom is known as electron affinity. As the atomic structure for different materials are different, the electron affinity of different materials will differ. If two different kinds of metals or metallic compounds are immersed in the same electrolyte solution, one of them will gain electrons and the other will release electrons. Which metal (or metallic compound) will gain electrons and which will lose them depends upon the electron affinities of these metals or metallic compounds. The metal with low electron affinity will gain electrons from the negative ions of the electrolyte solution as shown in figure 2.

Microcontrollers of RISC Architecture: PIC16F877 belongs to a class of 8-bit microcontrollers of RISC architecture. It has 8kb flash memory for storing a written program. Since memory made in FLASH technology can be programmed and cleared more than once, it makes this microcontroller suitable for device development. IT has data memory that needs to be saved when there is no supply. It is usually used for storing important data that must not be lost if power supply suddenly stops. For instance, one such data is an assigned temperature in temperature regulators. If during a loss of power supply this data was lost, we would have to make the adjustment once again upon return of supply as shown in figure 4.

LCD Display: LCD screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data as shown in figure 3.

Power Supply Characteristics: There are various factors that determine the quality of the power supply (shown in figure 4) like the load voltage, load current, voltage regulation, source regulation, output impedance, ripple rejection, and so on. Some of the characteristics are briefly explained below:

Load Regulation: The load regulation or load effect is the change in regulated output voltage when the load current changes from minimum to maximum value.
Load regulation = V no-load – V full-load
V no-load – Load Voltage at no load
V full-load – Load voltage at full load
From the above equation we can understand that when Vno-load occurs the load resistance is infinite, that is, the out terminals are open circuited. Vfull-load occurs when the load resistance is of the minimum value where voltage regulation is lost.
% Load Regulation = [(V no-load – V full-load)/V full-load] * 100

Minimum Load Resistance: The load resistance at which a power supply delivers its full-load rated current at rated voltage is referred to as minimum load resistance.
Minimum Load Resistance = V full-load/I full-load
The value of I full-load, full load current should never increase than that mentioned in the data sheet of the power supply.

Source/Line Regulation: In the block diagram, the input line voltage has a nominal value of 230 Volts but in practice, here are considerable variations in ac supply mains voltage. Since this ac supply mains voltage is the input to the ordinary power supply, the filtered output of the bridge rectifier is almost directly proportional to the ac mains voltage. The source regulation is defined as the change in regulated output voltage for a specified rage of lie voltage.

Output Impedance: A regulated power supply is a very stiff dc voltage source. This means that the output resistance is very small. Even though the external load resistance is varied, almost no change is seen in the load voltage. An ideal voltage source has an output impedance of zero.

Ripple Rejection: Voltage regulators stabilize the productivity voltage against variations in input voltage. Ripple is equivalent to a periodic variation in the input voltage. Thus, a voltage regulator attenuates the ripple that comes in with the unregulated input voltage. Since a voltage regulator uses negative feedback, the distortion is reduced by the same factor as the gain.

Relay: Relays are simple switches which are operated both electrically and mechanically. Relays consist of an electromagnet and also a set of contacts. The switching mechanism is carried out with the help of the electromagnet. There are also other operating principles for its working. But they differ according to their applications. Most of the devices have the application of relays.

Flowchart: The proposed method flow diagram is mention in figure 5.

MPLAB IDE - Software Analysis: MPLAB IDE is a software program (in figure .6) that runs on a PC to develop applications for Microchip Microcontrollers. It is called an Integrated Development Environment, or IDE, because it provides a single integrated environment to develop code for embedded microcontrollers. An embedded system is typically a design making use of the power of a small microcontroller. These microcontrollers combine a microprocessor unit (like the CPU in a desktop PC) with some additional circuits called peripherals, plus some additional circuits on the same chip to make a small control module requiring few other external devices. This single device can then be embedded into other electronic and mechanical devices for low-cost digital control. The main difference between an embedded controller and a PC is that the embedded controller is dedicated to one specific task or set of tasks. A PC is designed to run many different types of programs and to connect too many different external devices. An embedded controller has a single program and, as a result, can be made cheaply to include just enough computing power and hardware to perform that dedicated task. A PC has a relatively expensive generalized central processing unit (CPU) at its heart with many other external devices (memory, disk drives, video

controllers, network interface circuits, etc.,). An embedded system has a low-cost microcontroller unit (MCU) for its intelligence, with many peripheral circuits on the same chip, and with relatively few external devices. Often, an embedded system is an invisible part, or sub-module of another product, such as a cordless drill, refrigerator or garage door opener. The controller in these products does a tiny portion of the function of the whole device. The controller adds low-cost intelligence to some of the critical sub-systems in these devices.

CONCLUSION

The designed microcontroller based wireless functional electrical stimulation device has been successfully applied and tested on profuse simulation and gives the desired value of electrical pulse. The wireless functional electrical stimulation device has been solved the cable complexity and foot sensors wire discomfort with the design of wireless system. The stimulator power consumption is very low because of the special design. While the patient is waiting in the stand case and also raising the patient's foot while setting or off shoe without closure device the processor shuts off system and system enters the low current sleep mode with practically no current consumption also. As soon as an activity has been detected, the functional electrical stimulation automatically wakes up and stimulation starts again with detection of the foot-rise, thus reducing patient interaction.

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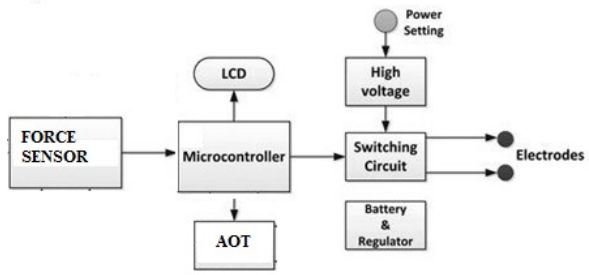

Figure 1: Block Diagram

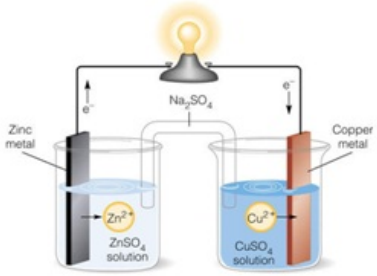

Figure 2: Battery Connection

Figure 3: 16x2 LCD

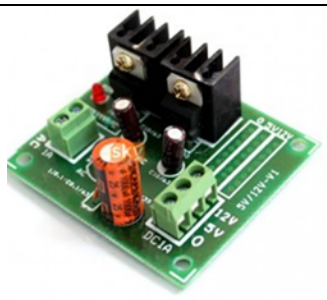

Figure 4: Power Supply Module

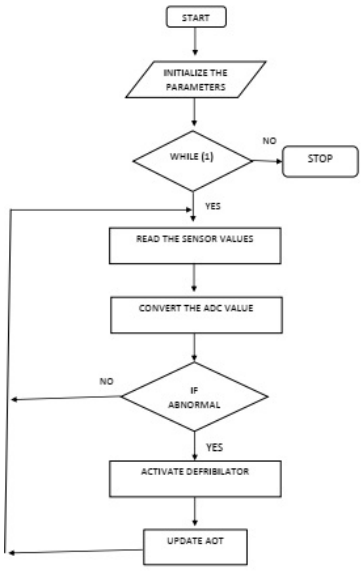

Figure 5: Flow Chart

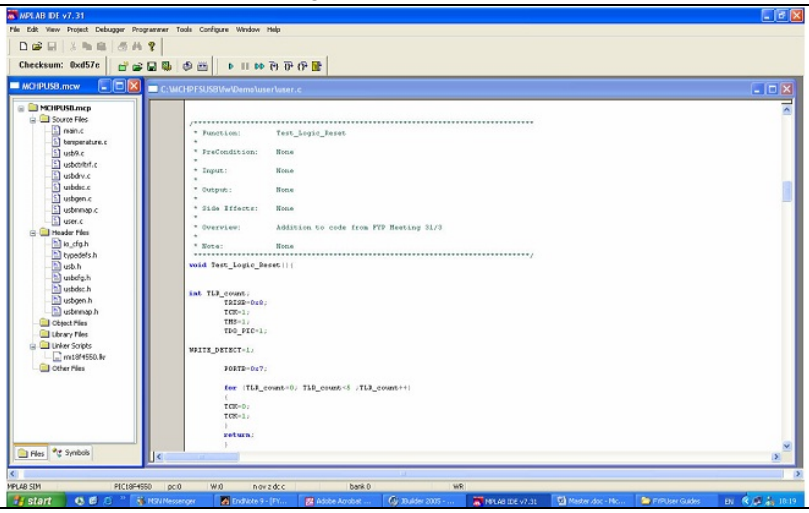

Figure 6: MPLAB IDE Converts Source Code into Machine Instructions

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RESEARCH ARTICLE

The GC MS Study of One Skincare Ayurvedic Medicine, Pathadi Churnam

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ABSTRACT

The present study deals with the GC MS analysis of one Ayurvedic formulation, Pathadichrunam. The medicine was procured from standard Ayurvedic vendor at Chennai, India and was suitably processed before subjecting it to GC MS analysis. Some important molecules such as Methyl 4,7,10,13-hexadecatetraenoate, Z,E-2,13-Octadecadien-1-ol, trans-2-methyl-4-n-pentylthiane, S,S-dioxide, Chloroacetic acid, pentadecyl ester, 2H-Benzocyclohepten-2-one, decahydro-9a-methyl-, trans-, 17-Octadecynoic acid, n-Hexadecanoic acid, 5,8,11,14,17-Eicosapentaenoic acid, 11,13-Dimethyl-12-tetradecen-1-ol acetate, Sulfurous acid, butyl heptadecyl ester, 9-Octadecenoic acid, (E)-, Acetic acid, chloro-, octadecyl ester, Fenretinide, trans-Geranylgeraniol, Octadecanoic acid, (2-phenyl-1,3-dioxolan-4-yl)methyl ester, cis-, 1-Heptatriacotanol etc. were observed in the GC MS profile which have far reaching medicinal role. It is concluded that the molecules present in Pathadichrunam could contribute to its medicinal role.

Salihajakir Hussain

Keywords: GC MS, Ayurvedic, Pathadi Churnam, Chloroacetic acid, Sulfurous acid, butyl heptadecyl ester, Fenretinide.

INTRODUCTION

The present study is one among our works in which we are trying to understand the molecules present in Ayaurvedic medicines by subjecting them to GC MS analysis [1-25]. In this report the GC MS analysis report of one medicine, Pathadichurnam is shown. Pathadichurnam is made by mixing equal quantities of fine powders of the following ingredients. *Cissampelos pariera, Piper longum, Piper chaba, Solanum melongena, Zingiber officinalis, Plumbago zeylanica, Piper longum* root, *Cuminum cyminum*, *Curcuma longa*, and *Cyperus rotundus* root. This medicine is prescribed for the treatment of inflammatory conditions, skin disease and gum ailments such as bleeding gums. One to three grams of the medicine is taken orally mixed with water or honey. The same can be applied to the gums and teeth and washed and gargled after sometime.

MATERIALS AND METHODS

Pathadichurnamwas obtained from standard Ayurvedic vendor at Chennai and was subjected to GC MS analysis by standard procedure.

Sample Preparation

100 micro lit sample Dissolved in 1 ml of suitable solvents. The solution stirred vigorously using vortex stirrer for 10 seconds. The clear extract was determined using gas-chromatography for analysis. The compounds are identified by GC-MS Library (NIST & WILEY).

RESULTS

The GC MS profile of Pathadichurnam is represented in Figure 1. Table1 indicates the retentions values, types of possible compound, their molecular formulae, molecular mass, peak area and their medicinal roles of each compound as shown in the GC MS profile of Pathadichurnam. The identification of metabolites was accomplished by comparison of retention time and fragmentation pattern with mass spectra in the NIST spectral library stored in the computer software (version 1.10 beta, Shimadzu) of the GC-MS along with the possible pharmaceutical roles of each bio molecule as per Dr. Duke's Phytochemical and ethnobotanical data base (National Agriculture Library, USA) and others as shown in Table 1 [26].

DISCUSSION

Some of the molecules shown in the GC MS profile of Pathadichurnam, such as, Methyl 4,7,10,13-hexadecatetraenoate, Z,E-2,13-Octadecadien-1-ol, trans-2-methyl-4-n-pentylthiane, S,S-dioxide, Chloroacetic acid, pentadecyl ester, 2H-Benzocyclohepten-2-one, decahydro-9a-methyl-, trans-, 17-Octadecynoic acid, n-Hexadecanoic acid, 5,8,11,14,17-Eicosapentaenoic acid, 11,13-Dimethyl-12-tetradecen-1-ol acetate, Sulfurous acid, butyl heptadecyl ester, 9-Octadecenoic acid, (E)-, Acetic acid, chloro-, octadecyl ester, Fenretinide, trans-Geranylgeraniol, Octadecanoic acid, (2-phenyl-1,3-dioxolan-4-yl)methyl ester, cis-, 1-Heptatriacotanol etc. have far reaching medicinal roles which could contribute to the function of this medicine. Further work is in progress to prove the efficacy of the medicine.

CONCLUSION

It is concluded that with so many important biomolecules with many medicinal roles could contribute to the action of Pathadichurnam.

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Table1. Indicates the retentions values, types of possible compound, their molecular formulae, molecular mass, peak area and their medicinal roles of each compound as shown in the GC MS profile of Pathadi Churnam

Sl. No	Retention Time	Compound Name	Mol. Formula	Mol. Weight	% Peak Area	Possible medical Role
1	9.77	Naphthalene, 1,2,3,4-tetrahydro-1,6-dimethyl-4-(1-methylethyl)-, (1S-cis)-	C15H22	202.2	1.04	Not known
2	9.90	Cyclopentane, 1-pentyl-2-propyl-	C13H26	182.2	0.56	Not known
3	10.60	9-Eicosyne	C12H25F	278.3	0.57	Not known
4	10.82	7,11-Hexadecadienal	C16H28O	236.2	0.57	Not known
5	11.49	Methyl 4,7,10,13-hexadecatetraenoate	C17H26O2	262.2	0.63	Catechol-O-methyl transferase inhibitor, Methyl-Donor, Methyl-Guanidine-Inhibitor
6	11.71	Z,E-2,13-Octadecadien-1-ol	C18H34O	266.3	1.79	Increases Zinc bioavailability, Oligosaccharide provider, Anticancer, antidote, Cytochrome-P450-2E1-inhibitor, Decrease C-telopeptide excretion, decrease

						sdecarboxypyridinoline excretion, decreases endothelial leukocyte adhesion, decreases endothelial platelet adhesion, decreases epinephrine production, decreases oxalate excretion
7	11.92	Butyl 9-tetradecenoate	C18H34O2	282.3	0.60	Not known
8	12.27	trans-2-methyl-4-n-pentylthiane, S,S-dioxide	C11H22O2S	218.1	1.13	Increases Glutathione Transferase activity, Myoneuro stimulant, Nitric oxide synthase inhibitor, NO-Scavenger, stimulates Norepinephrine production, stimulates sympathetic nervous system, Catechol-O-methyl transferase inhibitor, smart drug, adrenocortical stimulant, ANS stimulant, anticancer
9	12.58	Chloroacetic acid, pentadecyl ester	C17H33ClO2	304.2	0.92	Acidifier, Arachidonic acid Inhibitor, Increases Aromatic Amino acid decarboxylase activity, Inhibit production of uric acid, Urine acidifier
10	13.02	2H-Benzocyclohepten-2-one, decahydro-9a-methyl-, trans-	C12H20O	180.2	1.35	Catechol-O-Methyl-Transferase-Inhibitor, Increase Glutathione-S-Transferase (GST) Activity, Decreases Glutamate Oxaloacetate Transaminase, Decreases Glutamate Pyruvate Transaminase, Glucosyl-Transferase-Inhibitor, Glutathione-S-Transferase-Inhibitor, Increase Glyoxalate Transamination, Reverse-Transcriptase-Inhibitor, Transdermal, Anti-5-HT, Anti-HIV-Integrase, Antidote, Aryl-Hydrocarbon-Hydroxylase-Inhibitor, HIF-1alpha-Inhibito, Increase Tyrosine Hyroxylase Activity,

						Suppress HMG-CoA Reductase Activity, Tyrosine-Hyroxylase-Activator, Catechol-O-Methyltransferase-Inhibitor
11	13.84	1-Nonylcycloheptane	C16H32	224.3	6.25	Not known
12	14.51	n-Hexadecanoic acid	C16H32O2	256.2	2.66	Acidifier, Arachidonic acid Inhibitor, Increases Aromatic Amino acid decarboxylase activity, Inhibit production of uric acid, Urine acidifier
13	14.53	5,8,11,14,17-Eicosapentaenoic acid	C20H30O2	302.2	4.43	acidifier, Arachidonic acid Inhibitor, Increase Aromatic Amino acid decarboxsylase activity, Inhibit production of uric acid, Urine acidifier
14	15.10	11,13-Dimethyl-12-tetradecen-1-ol acetate	C18H34O2	282.3	1.27	Oligosaccharide provider
15	15.66	17-Octadecynoic acid	C18H32O2	280.2	1.44	acidifier, Arachidonic acid Inhibitor, Increases Aromatic Amino acid decarboxylase activity,s Inhibit production of uric acid, Urine acidifier
16	15.71	5-Eicosene, (E)-	C20H40	280.3	5.96	Not known
17	15.78	Sulfurous acid, butyl heptadecyl ester	C21H44O3S	376.3	11.60	Acidifier, Arachidonic acid Inhibitor, Increases Aromatic Amino acid decarboxylase activity, Inhibit production of uric acid, Urine acidifier
18	15.82	13-Tetradecenal	C14H26O	210.2	0.64	Not known
19	16.10	9,12-Octadecadienoyl chloride, (Z,Z)-	C18H31ClO	298.2	10.46	Provides Zinc
20	16.36	9-Octadecenoic acid, (E)-	C18H34O2	282.3	0.83	Arachidonic acid Inhibitor, Increases Aromatic Amino acid decarboxylase activity, Inhibit production of uric acid, Urine acidifier, Catechol O Methyl transferase inhibitor, Methyl donor, Methyl guanidine inhibitor, Acidifier
21	16.65	Dodecane, 1-fluoro-		188.32	6.80	Not known
22	17.00	11,13-Dimethyl-12-tetradecen-1-ol acetate	C18H34O2	282.3	1.56	Oligosaccharide provider
23	19.08	1-Decanol, 2-hexyl-	C16H34O	242.3	5.80	Not known

24	20.52	Acetic acid, chloro-, octadecyl ester	C20H39ClO2	346.3	1.30	acidifier, Arachidonic acid Inhibitor, Increases Aromatic Amino acid decarboxylase activity, Inhibits production of uric acid, Urine acidifier
25	21.19	Fenretinide	C26H33NO2	391.3	13.46	Chemopreventive against prostate cancer and in women at risk of developing contralateral breast cancer and effective antineoplastic agent.
26	21.39	trans-Geranylgeraniol	C20H34O	290.3	2.77	Catechol-O-Methyl-Transferase-Inhibitor, Increase Glutathione-S-Transferase (GST) Activity, Decreases Glutamate Oxaloacetate Transaminase, Decrease Glutamate Pyruvate Transaminase, Glucosyl-Transferase-Inhibitor, Glutathione-S-Transferase-Inhibitor, Increase Glyoxalate Transamination, Reverse-Transcriptase-Inhibitor
27	22.32	Norethynodrel	C20H26O2	298.2	2.51	Not known
28	22.59	Octadecane, 3-ethyl-5-(2-ethylbutyl)-	C26H54	366.4	1.80	Not known
29	22.92	Octadecanoic acid, (2-phenyl-1,3-dioxolan-4-yl)methyl ester, cis-	C28H46O4	446.3	0.52	Arachidonic acid Inhibitor, Increases Aromatic Amino acid decarboxylase activity, Inhibit production of uric acid, Urine acidifier, Catechol O Methyl transferase inhibitor, Methyl donor, Methyl guanidine inhibitor, Acidifier
30	23.23	1-Heptatriacotanol	C37H76O	536.6	3.41	Antibacterial, anticancer, antiprotozoal, chemopreventive, and antiinflammatory properties, antimalarial, anti-flu, antiviral, antiprotozoal, antioxidant, anti-peroxidant, antitumor,

						anticancer, enzyme inhibitor, anti-hypercholesterolemic effects
31	23.37	Dihydrotestosterone 3-formate-17-benzoate	C27H34O4	422.2	1.03	Not known
32	24.31	Megestrol acetate	C24H32O4	384.2	0.98	Not known

Qualitative Compound Report

Data File	220620027.D	Sample Name	Pathadi Churnam
Sample Type		Position	105
Acq Method	GC Screening Method.M	Acquired Time	24-06-2020 PM 01:53:40
Comment			

User Chromatogram

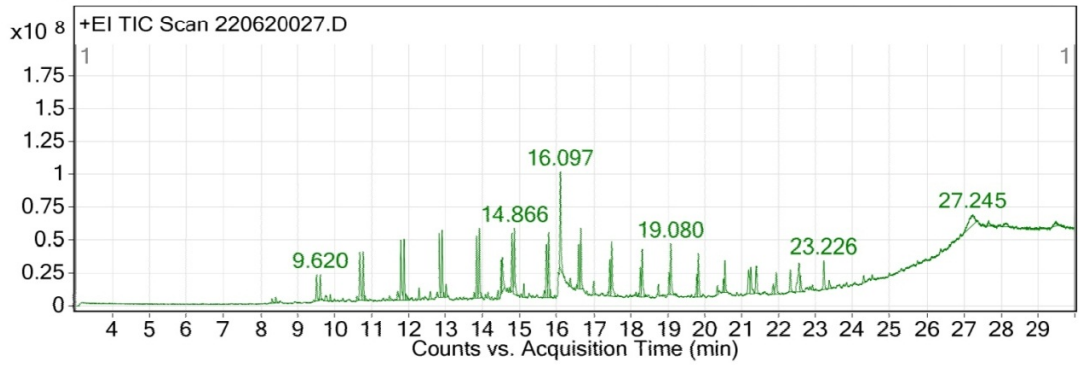

Figure 1 indicates the GC MS profile of Pathadichurnam

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REVIEW ARTICLE

Clinical Aspects of Breast Cancer-A Mini Review

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ABSTRACT

Breast cancer is the most frequent malignancy in women worldwide and is curable in 70–80% of patients with early-stage, non-metastatic disease. Advanced breast cancer with distant organ metastases is considered incurable with currently available therapies. On the molecular level, breast cancer is a heterogeneous disease, molecular features include activation of human epidermal growth factor receptor 2 (HER2, encoded by ERBB2), activation of hormone receptors (oestrogen receptor and progesterone receptor) and/or BRCA mutations. Treatment strategies differ according to molecular subtype. Management of breast cancer is multidisciplinary, it includes local-regional (surgery and radiation therapy) and systemic therapy approaches. Systemic therapies include endocrine therapy for hormone receptor-positive disease, chemotherapy and quite recently immunotherapy. This review mainly focused about the clinical aspects of breast cancer.

Keywords: Breast cancer, Diagnosis, Mammography, Therapy.

INTRODUCTION

Cancer is a deregulation of cell growth. Cancer results from alterations in the DNA of a somatic cell during the lifetime of the affected individual [1]. Cancer cells proliferate in an uncontrolled manner, forming malignant tumors. Malignant tumors tend to metastasize. Cancer is the focus of massive research effort. Modern research has focused on the roll of oncogenes and proto-oncogenes in the etiology of tumors. People likely have wondered about the cause of cancer for centuries. Its name derives from an observation by Hippocrates more than 2,300 years ago that the long, distended veins that radiate out from some breast tumors look like the limbs of a crab [2]. From that observation came the term Karkinoma in Greek and later, Cancer in Latin. Cancer begins when a cell breaks free from the normal restraints on cell division and begins to follow its own agenda for proliferation. All of the cells produced by division

of this first, ancestral cell and its progeny also display inappropriate proliferation [3]. A tumor, or mass of cells may remain within the tissue in which it originated (a condition called in situ cancer) or it may begin to invade nearby tissues (a condition called invasive cancer).An invasive tumor is said to be malignant and cells shed into the blood or lymph from a malignant tumor are likely to establish new tumors (metastases) throughout the body. Tumors threaten an individual's life when their growth disrupts the tissues and organs needed to survival. Breast cancer is the most frequent disease diagnosed in women, accounting for more than one in every ten new cancer diagnoses each year in the United States. It is the second most common cause of cancer death among women in the globe, after lung cancer [4]. Breast cancer evolves silently and most disease is discovered on routine screening. This activity reviews the pathophysiology, presentation and diagnosis of breast cancer and highlights the role of the interprofessional team in its management.

Types of Breast Cancer

Ductal cancer

Ductal cancer is a type of cancer that develops in the milk ducts [5].

Lobular cancer

Lobular cancer is a type of cancer that develops in the lobules that produce milk.

Ductal Carcinoma InSitu (DCIS)

DCIS is the most common type of non-invasive breast cancer [6]. This has a high survival rate, best detected with a mammogram and having higher risk for reoccurrence or for developing a new breast cancer [7].

Invasive Ductal Carcinoma (IDC)

This is the most common type of breast cancer which accounts for around 80% of all cases. This kind of breast cancer begins in the ducts and breaks through a wall to invade the fat tissue of the breast. IDC has the ability to spread through the lymphatic system and into the bloodstream. Men are also affected by IDC [8].

Invasive Lobular Carcinoma (ILC)

ILC is the second most frequent type of breast cancer, accounting for 10 percent of all cases. It begins in the lobules but, like IDC, can spread to other regions of the body if left untreated [9]. In opposed to IDC, this kind of cancer is more difficult to detect using a mammography.

Inflammatory Breast Cancer (IBC)

IBC is a rare form of breast cancer that accounts for 1-3 percent of all incidences of breast cancer in the United States. Instead of a noticeable lump, IBC manifests itself as a reddening and swelling of the breast tissue [10]. It may also have a thick, pitted appearance, similar to that of an orange peel, depending on the strain [11]. A mammography may be ineffective if there is no lump to be found. IBC has a lower prognosis than other cancers because it is frequently misdiagnosed as an infection, has a greater rate of metastasis, and is more difficult to diagnose [12].

Triple Negative Breast Cancer

Usually IDC whose cells lack oestrogen and progesterone receptors and don't have an excess of the HER2 protein on their surfaces. This form of cancer tends to be more aggressive and harder to treat than others and has a higher prevalence in younger women and African-American women [13].

Lobular Carcinoma InSitu (LCIS)

LCIS means that cells inside the lobules have started to become abnormal. This raises a person's risk of developing cancer but is not a cancer itself. LCIS is usually diagnosed before menopause present in both breasts and is extremely uncommon in men.

Paget's disease of the nipple

This cancer starts in the breast ducts, spreads to the nipple surface and then the areola. It makes up 1% of all cases of breast cancer. The nipple and areola often appear crusted and red, with the possibility of bleeding and oozing [14]. This is often related to either DCIS or IDC, with treatment often requiring a mastectomy, it may also occur in men.

Etiology of Breast Cancer

A variety of risk factors for breast cancer have been well-established by epidemiologic studies including race, ethnicity, family history of cancer, and genetic traits, as well as modifiable exposures such as increased alcohol

consumption, physical inactivity, exogenous hormones, and certain female reproductive factors. Younger age at menarche, parity, and older age at first full-term pregnancy may influence breast cancer risk through long-term effects on sex hormone levels or by other biological mechanisms.

Pathophysiology of Breast Cancer

It is believed that estrogen exposure has an impact on the development of breast cancer since DNA damage and genetic mutations are responsible for the disease's development. It is possible that DNA abnormalities or pro-cancerous genes such as BRCA1 and BRCA2 will be passed down through families. As a result, having a family history of ovarian or breast cancer increases the likelihood of developing breast cancer. In a healthy individual, the immune system targets cells that have aberrant DNA or are undergoing abnormal development [15]. Patients with breast cancer disease experience failure, which results in tumor growth and spread. Breast cancer can be classified as either invasive or non-invasive depending on how it interacts with the basement membrane. LCIS (lobular carcinoma in situ) and ductal carcinoma in situ (DCIS) are the two principal forms of noninvasive neoplasms of the breast that can be distinguished (DCIS) [16].

LCIS is considered to be a risk factor for the development of invasive breast cancer (BRCA). LCIS is distinguished by its conformance to the contour of the normal lobule, as well as by the presence of enlarged and filled acini in the lobule. Compared to LCIS, DCIS has greater morphological heterogeneity, and pathologists distinguish between four major kinds of DCIS: papillary, cribriform, solid, and comedo. DCIS is distinguished by the presence of distinct gaps filled with malignant cells, which are frequently surrounded by a discernible basal cell layer composed of what appear to be normal myoepithelial cells. The papillary and cribriform kinds of DCIS are often lower grade lesions that may take more time to progress to invasive malignancy than other types of the condition. Generally speaking, the solid and comedo forms of DCIS are more severe. Unless treated, DCIS usually progresses to aggressive cancer and spreads throughout the body [17].

Cancers that have invaded a glandular organ are distinguished by their lack of general architecture, their infiltration haphazardly into a variable quantity of stroma, or the creation of sheets of continuous and monotonous cells that show no regard for the structure and function of a glandular organ. Pathologists categorize invasive breast cancer into two histologic types: ductal and lobular. Breast cancer, particularly invasive ductal cancer, grows as a cohesive mass that appears as discrete abnormalities on mammograms and can be felt as a discrete lump in the breast that is smaller than lobular malignancies. Invasive ductal cancer is less common than lobular cancer. Invasive lobular cancer has a tendency to spread in a single-file fashion across the breast, which explains why it is clinically occult and often goes undetected on mammography or physical examination until the illness has spread significantly. It accounts for 50 percent to 70 percent of all invasive breast cancers. Invasive ductal cancer, also known as infiltrating ductal carcinoma, is the most frequent type of breast cancer.

As much as 10 percent of all breast cancers are invasive lobular carcinoma, and mixed ductal and lobular carcinomas are increasingly being diagnosed and characterized in pathology reports [18]. The characteristics of differentiated invasive ductal scarcinomas are identified and the cancers are given names based on these characteristics. It is referred to as infiltrating tubular carcinoma when the infiltrating cells form tiny glands lined by a single row of bland epithelium. A large amount of mucin may be secreted by invading cells, which may cause them to appear to float in the mucin solution. Mucinous tumors and colloid tumors are the terms used to describe these types of lesions, respectively. The majority of tubular and mucinous tumors are of low grade (grade I), and they account for roughly 2 percent to 3 percent of all invasive breast carcinomas. Medullary cancer is distinguished by the presence of unusual invasive cells with high-grade nuclear characteristics, numerous mitoses, and the absence of an in-situ component [19]. An infiltrate of tiny mononuclear lymphocytes surrounds the tumor, which seems to form sheets of cells in an almost syncytial pattern. Instead of infiltrating or permeating the stroma, the tumor's edges push into the surrounding breast tissues. Medullary carcinoma is a rare type of breast cancer that accounts for just around 5% of all breast cancer cases in its pure form.

Histopathology Report

The following are the major sections of a pathology report for a patient with breast cancer [20].

- Non-Invasive
- Rate of Cell Growth
- Cell Grade
- Tumour Necrosis (Cell Death)
- Size of Tumor
- Surgical Margins
- Vascular or Lymphatic Invasion
- Ploidy
- Hormone Receptor Status
- Her2status

Psychological Impact of a Breast Cancer

Diagnosis of breast cancer can be devastating and can trigger several adverse reactions for the majority of women. Many women can develop symptoms of psychological distress such as anxiety, depression, fatigue, pain, difficulty concentrating, social isolation, sexuality concerns, and self-blame [21]. When a woman receives a cancer diagnosis, she is likely to have the following emotional reactions [22]. Shock and resentment, Panic, anxiety, fear, Feelings of anger and hatred, Depression and denying of one's own feelings. A feeling of hopelessness, uncertainty and a sense of loneliness, fatigue and vulnerability.

Diagnosis of Breast Cancer

Early-stage cancer identification has the potential to drastically lower breast cancer mortality rates in the long term. The identification of early-stage cancer cells is the most crucial step in determining the best prognosis. A variety of breast diagnostic procedures have been investigated by investigators. These approaches include mammography, magnetic resonance imaging (MRI), ultrasound, computed tomography, positron emission tomography, and biopsy [23]. However, there are certain limits to these treatments, such as the fact that they are expensive, time-consuming, and not ideal for young women. It is critical to develop a high-sensitivity and quick early-stage breast cancer diagnostic tool as soon as possible. During the past several years, researchers have concentrated their efforts on the creation of biosensors that can detect breast cancer using a variety of biomarkers. Aside from biosensors and biomarkers, microwave imaging techniques have also been extensively researched as a viable diagnostic tool for early-stage breast cancer detection that is both quick and cost-effective, particularly in developing countries.

Mammography

Mammography is a screening or diagnostic tool used to detect breast masses or microcalcifications in women by using low energy X-Ray's that are often not palpable during a physical exam [24]. During a mammography each breast is placed between two plates and compressed so that a clear image is obtained. During a screening mammography 2 X-Rays are taken of each breast of asymptomatic women to detect change at a preclinical stage, this is the primary role of mammography [25]. After analyzing mammographic images, radiologists classify findings into five categories. Any calcification found on mammographic examination needs further examination [26].

Diagnostic Mammography

Diagnostic mammography is used to evaluate individuals with abnormal clinical findings to potentially characterize possible abnormalities detected by screening. A diagnostic mammography includes additional views such as spot compression or magnification views for a more detailed report [27].

Fine Needle Aspiration

Fine Needle Aspiration (FNA) is a diagnostic technique of tumours and has widely used in the diagnosis of breast lesions [28]. Its sensitivity is 65-98% and specificity is 34-100% in diagnosing breast lesions.

Core Needle Biopsy

Cone Needle Biopsy (CNB) provides material for histological evaluation. This technique is often used when there is no skilled cytopathologist to evaluate results from a Fine Needle Aspiration (FNA). CNB has the ability to distinguish between invasive cancer from ductal carcinoma in situ unlike FNA.

Excisional Biopsy

Excisional Biopsy is the complete surgical removal of a palpable breast lesion and is indicated if Needle biopsy is not feasible or if it is non-diagnostic or discordant with imaging results [29].

Signs and Symptoms

Signs and symptoms of breast cancer may include.

- A breast lump or thickening that feels different from the surrounding tissue.
- Change in the size, shape or appearance of a breast.
- Changes to the skin over the breast, such as dimpling [30].
- A newly inverted nipple.
- Peeling, scaling, crusting or flaking of the pigmented area of skin surrounding the nipple (areola) or breast skin [31].
- Redness or pitting of the skin over your breast, like the skin of an orange.

Pharmacotherapy of Breast Cancer

In breast cancer care, different treatment such as surgery, radiation oncology, and medical oncology work together to create a patient's overall treatment plan that combines different types of treatments [32]. It includes chemotherapy, radiation therapy, hormone therapy, lymph node removal and analysis., reconstructive (Plastic) Surgery, external breast form (Prostheses), targeted therapy and Immunotherapy.

Complementary Therapies of Breast Cancer

These are also many complementary therapies that help to promote well-being and manage symptoms related to breast cancer and its treatment [33]. It includes acupuncture, Aromatherapy, biofeedback, cognitive behavioral therapy, dance Therapy, energy healing, gentle massage, hypnotherapy, meditation, nutrition therapy, relaxation therapy, stress management, Tai Chi, visualization and Yoga.

Breast Reconstruction of Breast Cancer

Breast reconstruction surgery involves reshaping the breast mound so that it is about the same size and shape as it was before the procedure [34]. It is of two types.

1.Immediate Breast Reconstruction Surgery in One Stage [35].

2.Surgical Reconstruction in Two Stages [36], also known as Two-Staged Reconstruction.

It is also possible to include the nipple and the areola. The majority of women who have had a mastectomy are eligible for reconstruction [37]. Women who have undergone a lumpectomy may not require reconstructive surgery.

CONCLUSION

Now a day, breast cancer treatment plans are usually put together and carried out, in certified breast cancer or tumor centers, or in doctor's practices specializing in oncology. There are specialists from different discipline work together to treat the various effects that both the disease and the treatment have on body and mind. Awareness about breast cancer is incredibly important as early detection, often through screening, can catch the disease when it is most treatable. Hence it was concluded from the study that there is a need to educate and improve disease awareness among the patients and it is also important in the early diagnosis and management of breast cancer.

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